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ENGINEERING CHANGE NOTICE

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1. ECN 635597

Proj. ECN

2. ECN Category (mark one)	3. Originator's Name, Organization, MSIN, and Telephone No.	4. USQ Required?	5. Date
Supplemental [] Direct Revision [X] Change ECN [] Temporary [] Standby [] Supersedure [] Cancel/Void []	John M. Conner, Data Assessment and Interpretation, R2-12, 373-2711	[] Yes [X] No	03/23/98
	6. Project Title/No./Work Order No. Tank 241-B-107	7. Bldg./Sys./Fac. No. 241-B-107	8. Approval Designator N/A
	9. Document Numbers Changed by this ECN (includes sheet no. and rev.) HNF-SD-WM-ER-723, Rev. 0	10. Related ECN No(s). N/A	11. Related PO No. N/A

12a. Modification Work	12b. Work Package No.	12c. Modification Work Complete	12d. Restored to Original Condition (Temp. or Standby ECN only)
[] Yes (fill out Blk. 12b) [X] No (NA Blks. 12b, 12c, 12d)	N/A	N/A Design Authority/Cog. Engineer Signature & Date	N/A Design Authority/Cog. Engineer Signature & Date

13a. Description of Change 13b. Design Baseline Document? [] Yes [X] No

The document has been totally revised to include the results of recent sampling to address technical issues associated with the waste, and to update the best basis standard inventory.

14a. Justification (mark one)

Criteria Change	[X]	Design Improvement	[]	Environmental	[]	Facility Deactivation	[]
As-Found	[]	Facilitate Const	[]	Const. Error/Omission	[]	Design Error/Omission	[]

14b. Justification Details

Changes required to incorporate new sampling data.

15. Distribution (include name, MSIN, and no. of copies)

See attached distribution.

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16. Design Verification Required	17. Cost Impact				18. Schedule Impact (days)	
	ENGINEERING		CONSTRUCTION			
[] Yes	Additional	[] $	Additional	[] $	Improvement	[]
[X] No	Savings	[] $	Savings	[] $	Delay	[]

19. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 13. Enter the affected document number in Block 20.

SDD/DD	[]	Seismic/Stress Analysis	[]	Tank Calibration Manual	[]
Functional Design Criteria	[]	Stress/Design Report	[]	Health Physics Procedure	[]
Operating Specification	[]	Interface Control Drawing	[]	Spares Multiple Unit Listing	[]
Criticality Specification	[]	Calibration Procedure	[]	Test Procedures/Specification	[]
Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
Equipment Spec.	[]	Maintenance Procedure	[]	ASME Coded Item	[]
Const. Spec.	[]	Engineering Procedure	[]	Human Factor Consideration	[]
Procurement Spec.	[]	Operating Instruction	[]	Computer Software	[]
Vendor Information	[]	Operating Procedure	[]	Electric Circuit Schedule	[]
OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
FSAR/SAR	[]	IEFD Drawing	[]	Process Control Manual/Plan	[]
Safety Equipment List	[]	Cell Arrangement Drawing	[]	Process Flow Chart	[]
Radiation Work Permit	[]	Essential Material Specification	[]	Purchase Requisition	[]
Environmental Impact Statement	[]	Fac. Proc. Samp. Schedule	[]	Tickler File	[]
Environmental Report	[]	Inspection Plan	[]		[]
Environmental Permit	[]	Inventory Adjustment Request	[]		[]

20. Other Affected Documents: (NOTE: Documents listed below will not be revised by this ECN.) Signatures below indicate that the signing organization has been notified of other affected documents listed below.

Document Number/Revision	Document Number/Revision	Document Number Revision
N/A		

21. Approvals

	Signature	Date		Signature	Date
Design Authority			Design Agent		
Cog. Eng. J.M. Conner	JM Conner	4-28-98	PE		
Cog. Mgr. K.M. Hall	Kathleen M. Hall	4/28/98	QA		
QA			Safety		
Safety			Design		
Environ.			Environ.		
Other J.W. Cammann	JW Cammann	4/29/98	Other		
R.J. Cash	[illegible] for RJC	5/2/98	DEPARTMENT OF ENERGY		
			Signature or a Control Number that tracks the Approval Signature		
J.G. Kristofzski	[illegible]	4/29/98	ADDITIONAL		

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Tank Characterization Report for Single-Shell Tank 241-B-107

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U.S. Department of Energy Contract DE-AC06-87RL10930

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Abstract: This document summarizes the information on the historical uses, present status, and the sampling and analysis results of waste stored in Tank 241-B-107. This report supports the requirements of the Tri-Party Agreement Milestone M-44-15B.

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Tank Characterization Report for Single-Shell Tank 241-B-107

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LIST OF TERMS

1C	first decontamination cycle $BiPO_4$ process waste
ANOVA	analysis of variance
BSltCk	saltcake from 241-B Evaporator operations (1951-1953)
Btu/hr	British thermal units per hour
Ci	curie
Ci/L	curies per liter
CI	confidence interval
CW	$BiPO_4$ process aluminum cladding waste
CWP	plutonium-uranium extraction (PUREX) process aluminum cladding waste
cm	centimeter
DL	drainable liquid
DQO	data quality objective
DSC	differential scanning calorimetry
EB	evaporator bottoms
ft^2	square feet
g	gram
g/cm^3	grams per cubic centimeter
g/g	grams per gram
g/L	grams per liter
g/mL	grams per milliliter
GC/MS	gas chromatography/mass spectrometry
HDW	Hanford defined waste
HHF	hydrostatic head fluid
IC	ion chromatography
ICP	inductively coupled plasma (spectroscopy)
in.	inch
J/g	joules per gram
kg	kilogram
kgal	kilogallon
kL	kiloliter
kW	kilowatt
LFL	lower flammability limit
LH	lower half
LL	lower limit
m	meter
m^2	square meters
M	molarity
mg	milligram
mg/L	milligram per liter
mg/m^3	milligrams per cubic centimeter
mL	milliliter
n/a	not applicable
n/r	not reported
PHMC	Project Hanford Management Contractor
ppm	parts per million
ppmv	parts per million by volume
PUREX	plutonium-uranium extraction
QC	quality control
REML	restricted maximum likelihood estimation
RPD	relative percent difference
SAP	sampling and analysis plan

LIST OF TERMS (Continued)

SMM	supernatant mixing model
SpG	specific gravity
TCR	tank characterization report
TGA	thermogravimetric analysis
TIC	total inorganic carbon
TLM	tank layer model
TOC	total organic carbon
TWRS	Tank Waste Remediation System
UH	upper half
UL	upper limit
W	watt
WSTRS	Waste Status and Transaction Record Summary
wt%	weight percent
%	percent
°C	degrees Celsius
°F	degrees Fahrenheit
μCi/g	microcuries per gram
μCi/mL	microcuries per milliliter
μg/g	micrograms per gram
μg/mL	micrograms per milliliter

1.0 INTRODUCTION

A major function of the Tank Waste Remediation System (TWRS) is to characterize waste in support of waste management and disposal activities at the Hanford Site. Analytical data from sampling and analysis and other available information about a tank are compiled and maintained in a tank characterization report (TCR). This report and its appendices serve as the TCR for single-shell tank 241-B-107. The objectives of this report are 1) to use characterization data in response to technical issues associated with tank 241-B-107 waste and 2) to provide a standard characterization of this waste in terms of a best-basis inventory estimate. Section 2.0 summarizes the response to technical issues, Section 3.0 shows the best-basis inventory estimate, and Section 4.0 makes recommendations about the safety status of the tank and additional sampling needs. The appendices contain supporting data and information. This report supports the requirements of the *Federal Facility Agreement and Consent Order* (Ecology et al. 1997), Milestone M-44-15B, change request M-44-97-03, to "issue characterization deliverables consistent with the Waste Information Requirements Document developed for 1998."

1.1 SCOPE

The characterization information in this report originated from sample analyses and known historical sources. The results of recent sampling events will be used to fulfill the requirements of the data quality objectives (DQOs) and memoranda of understanding specified in Brown et al. (1997) for this tank. Other information can be used to support conclusions derived from these results. Appendix A contains historical information for tank 241-B-107 including surveillance information, records pertaining to waste transfers and tank operations, and expected tank contents derived from a process knowledge model. Appendix B summarizes sampling events (see Table 1-1), sample data obtained before 1989, and sampling results. Appendix C reports the statistical analysis and numerical manipulation of data used in issue resolution. Appendix D contains the evaluation to establish the best basis for the inventory estimate and the statistical analysis performed for this evaluation. Appendix E is a bibliography that resulted from an in-depth literature search of all known information sources applicable to tank 241-B-107 and its respective waste types. The reports listed in Appendix E are available in the Tank Characterization and Safety Resource Center.

Table 1-1. Summary of Recent Sampling.

Sample/Date[1]	Phase	Location	Segmentation	% Recovery
Vapor sample (combustible gas meter) (6/6/96)	Gas	Tank headspace, Riser 2, 6.1 m (20 ft) below top of riser	n/a	n/a
Vapor sample (7/23/96)	Gas	Tank headspace	n/a	n/a
Push core (9/5/97 to 9/8/97)	Solid/liquid	Riser 6	3 segments, upper half and lower half	84 - 100%
Push core (9/9/97 to 9/10/97)	Solid/liquid	Riser 2	4 segments, upper half and lower half	0 - 26%

Notes:
n/a = not applicable
[1]Dates are in the mm/dd/yy format.

1.2 TANK BACKGROUND

Tank 241-B-107 is located in the 200 East Area B Tank Farm on the Hanford Site. It is the first tank in a three-tank cascade series. The tank went into service in 1945, receiving first cycle decontamination (1C) waste from the bismuth phosphate process (Agnew et al. 1997). The tank was filled by the end of 1945 and continued to receive and cascade waste to tank 241-B-108 until 1946. From 1952 to 1954, waste was transferred from the tank. Additional waste was received from tank 241-B-106 in 1954, and supernatant was pumped to a crib. In 1957, waste was transferred to tank 241-C-109 for ferrocyanide scavenging.

Tank 241-B-107 received plutonium-uranium extraction (PUREX) cladding waste in 1963; some of this waste was cascaded to tank 241-B-108. In 1969, approximately two thirds of the waste in the tank was sent to tank 241-B-103. From 1972 to 1976, the tank received flush water and sent supernatant to tank 241-B-102.

Table 1-2 summarizes the description of tank 241-B-107. The tank has an operating capacity of 2,010 kL (530 kgal), and presently contains an estimated 625 kL (165 kgal) of noncomplexed waste (Hanlon 1997). The tank is not on the Watch List (Public Law 101-510).

Table 1-2. Description of Tank 241-B-107.

TANK DESCRIPTION	
Type	Single-shell
Constructed	1943-1944
In service	1945
Diameter	22.9 m (75.0 ft)
Operating depth	5.2 m (17 ft)
Capacity	2,010 kL (530 kgal)
Bottom shape	Dish
Ventilation	Passive
TANK STATUS	
Waste classification	Noncomplexed
Total waste volume	625 kL (165 kgal)
Supernatant volume	4 kL (1 kgal)
Saltcake volume	0 kL (0 kgal)
Sludge volume	621 kL (164 kgal)
Drainable interstitial liquid volume	45 kL (12 kgal)
Waste surface level (October 16, 1997)	138 cm (54.5 in.)
Temperature (November 12, 1991 to July 8, 1997)	13.8 to 20.4 °C (56.8 to 68.7 °F)
Integrity	Assumed leaker
Watch List	None
Flammable Gas Facility Group	3
SAMPLING DATE	
Vapor sample (combustible gas meter)	June 6, 1996
In-situ vapor sample	July 23, 1996
Push-mode core samples	September 1997
SERVICE STATUS	
Declared inactive	1976
Interim stabilization	March 1985
Intrusion prevention	October 1985

Note:

All recent temperature results are from thermocouples above the surface of the waste.

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2.0 RESPONSE TO TECHNICAL ISSUES

Four technical issues have been identified for tank 241-B-107 (Brown et al. 1997).

- **Safety screening:** Does the waste pose or contribute to any recognized potential safety problems?

- **Organic complexants:** Does the possibility exist for a point source ignition in the waste followed by a propagation of the reaction in the solid/liquid phase of the waste?

- **Hazardous vapor screening:** Do hazardous storage conditions exist associated with gases and vapors in the tank?

- **Organic solvents:** Does an organic solvent pool exist that may cause a fire or ignition of organic solvents in entrained waste solids?

Data from the 1997 push mode core sampling and analysis event and tank vapor space measurements provided the means to respond to the safety screening and organic complexant issues. Data from the July 1996 vapor sample provided the means to address the vapor screening and organic solvents issues. The responses are provided in the following sections. See Appendix B for sample and analysis data for tank 241-B-107.

2.1 SAFETY SCREENING

The data needed to screen the waste in tank 241-B-107 for potential safety problems are documented in *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995). These potential safety problems are exothermic conditions in the waste, flammable gases in the waste and/or tank headspace, and criticality conditions in the waste. Each condition is addressed separately below.

2.1.1 Exothermic Conditions (Energetics)

The first requirement outlined in the safety screening DQO is to ensure there are not sufficient exothermic constituents (organic or ferrocyanide) in tank 241-B-107 to pose a safety hazard. Because of this requirement, energetics in tank 241-B-107 waste were evaluated. The safety screening DQO required that the waste sample profile be tested for energetics every half segment to determine whether the energetics exceeded the safety threshold limit. The threshold limit for energetics is 480 J/g on a dry weight basis. Samples from the tank were analyzed using differential scanning calorimetry (DSC). No exotherms were detected for any sample.

2.1.2 Flammable Gas

Headspace measurements were taken from riser 2 on June 6, 1996. Flammable gas was detected to be 2 percent of the lower flammability limit (LFL). A measurement taken before core sampling detected 0 percent of the lower explosive limit. The lower flammability and lower explosive limits may be used interchangeably (NFPA 1995). Both results are below the safety screening limit of 25 percent of the LFL. Appendix B shows the data for vapor phase measurements.

2.1.3 Criticality

The safety screening DQO threshold for criticality, based on the total alpha activity, is 1 g/L. Because total alpha activity is measured in μCi/mL instead of g/L, the 1 g/L limit is converted into units of μCi/mL by assuming that all alpha decay originates from ^{239}Pu. The safety threshold limit is 1 g ^{239}Pu per liter of waste. Assuming that all alpha is from ^{239}Pu and using the most conservative sample result for density of 1.70 g/mL, 1 g/L of ^{239}Pu is 36.2 μCi/g of alpha activity. The maximum total alpha activity result was 0.0853 μCi/g (core 217, segment 1, lower half). The maximum upper limit to a 95 percent confidence interval on the mean was 0.126 μCi/g (core 217, segment 1, lower half), indicating the potential for a criticality event is extremely low. Therefore, criticality is not a concern for this tank. Appendix C contains the method used to calculate confidence limits.

2.2 ORGANIC COMPLEXANTS

The data required to support the issue of organic complexants are documented in *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements* (Schreiber 1997b). Energetics by DSC and sample moisture analyses were conducted to address the organic complexants issue. Because no exotherms were detected by DSC analysis, no further data were required to address the issue. According to the logic presented in Schreiber, the tank is safe with respect to the organic complexants issue.

2.3 HAZARDOUS VAPOR SAFETY SCREENING

The data required to support vapor screening are documented in *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995). The vapor screening DQO addresses two issues: 1) does the vapor headspace exceed 25 percent of the LFL, and if so, what are the principal fuel components; and 2) does the potential exist for worker hazards associated with the toxicity of constituents in any fugitive vapor emissions from these tanks?

2.3.1 Flammable Gas

This is the same requirement as the safety screening flammability requirement. As noted previously, flammable gas was not detected in the tank headspace. The results of two separate combustible gas meter screenings were 0 and 2 percent of the LFL.

2.3.2 Toxicity

The vapor screening DQO requires the analysis of ammonia (NH_3), carbon dioxide (CO_2), carbon monoxide (CO), nitric oxide (NO), nitrous oxide (N_2O), and nitrogen dioxide (NO_2) from a sample. The vapor screening DQO specifies a threshold limit for each of these compounds. Data from the July 26, 1996, vapor sampling event (Evans et al. 1997) were used to address the issue of toxicity (see Appendix B). All analytes were within the threshold limits. The toxicity issue has been closed for all tanks (Hewitt 1996).

2.4 ORGANIC SOLVENTS SAFETY SCREENING

The data required to support the organic solvent screening issue are documented in the *Data Quality Objective to Support Resolution of the Organic Solvent Safety Issue* (Meacham et al. 1997). The DQO requires analyzing tank headspace samples for total nonmethane organic compounds to determine whether the organic extractant pool in the tank is a hazard. This assessment determines that an organic solvent pool fire or ignition of organic solvents is credible.

Analytical results showed that the total non-methane organic concentration of the headspace was less than 0.59 mg/m^3 (Evans et al. 1997). This corresponds to a solvent pool of 0.12 m^2 (Huckaby et al. 1997). This is below the limit of 1 m^2 stated by Meacham et al.

2.5 PRETREATMENT

Tank 241-B-107 is not within the scope of the *Strategy for Sampling Hanford Site Tanks for Development of Disposal Technology* (Kupfer et al. 1995). However, archive samples from the tank could be used for pretreatment studies if requested.

2.6 OTHER TECHNICAL ISSUES

A factor in assessing tank safety is the heat generation and temperature of the waste. Heat is generated in the tanks from radioactive decay. An estimate of the tank heat load based on the 1997 sample event was not possible because radionuclide analyses were not required. However, the heat load estimate based on the tank process history was 56.77 W (194 Btu/hr)

(Agnew et al. 1997). The heat load estimate based on the tank headspace temperature was 605 W (2,067 Btu/hr) (Kummerer 1995). Both estimates are well below the limit of 11,700 W (40,000 Btu/hr) that separates high- and low-heat load tanks (Smith 1986).

2.7 SUMMARY

The results of all analyses performed to address potential safety issues showed that primary analytes did not exceed safety decision threshold limits. Recovery was poor for the second core (core 218). However, there is no indication that safety issues exist with the waste in tank 241-B-107. Table 2-1 summarizes the analytical results.

Table 2-1. Summary of Technical Issues. (2 sheets)

Issue	Sub-issue	Result
Safety screening	Energetics	No exotherms were observed in any sample.
	Flammable gas	Vapor measurements reported 0 and 2% of the LFL. (Combustible gas meter).
	Criticality	All analyses were well below 36.2 μCi/g total alpha (within 95 percent confidence limit on each sample).
Organic complexants	Safety categorization	No exotherms were detected. The tank is safe.
Hazardous vapor	Flammability	See safety screening - flammable gas.
	Toxicity	All analytes were within the toxicity threshold limits. The toxicity issue has been closed for all tanks.
Organic solvents	Solvent pool size	Total nonmethane hydrocarbons were <0.57 mg/m^3. The organic solvent pool is estimated to be 0.12 m^2.
Pretreatment	Analyses for treatment to separate low-level and high-level waste streams	Archive samples are available if analysis is requested in the future.

3.0 BEST-BASIS STANDARD INVENTORY ESTIMATE

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessments associated with waste management activities, and to address regulatory issues. Waste management activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing them into a form suitable for long-term storage.

Chemical and radiological inventory information are generally derived using three approaches: 1) component inventories are estimated using results of sample analyses, 2) component inventories are estimated using a model based on process knowledge and historical information, or 3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data. The information derived from these different approaches is often inconsistent.

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-B-107 was performed, including the following:

- Analytical data from five waste tanks (241-BX-107, 241-BX-112, 241-C-110, 241-T-104, and 241-T-107) which contain $BiPO_4$ process 1C solids. These tanks are expected to represent the $BiPO_4$ process 1C waste solids in tank 241-B-107.

- Analytical data from three waste tanks (241-B-109, 241-S-111, and 241-U-110) which contain cladding waste (CW) or remnants of CW.

- Analytical data from four waste tanks (241-B-104, 241-B-106, 241-B-108, and 241-B-109) which contain saltcake from the 241-B Evaporator operation in 1950 to 1956 (BSltCk). These tanks are expected to represent the BSltCk solids in tank 241-B-107.

- An inventory estimate generated by the Hanford defined waste (HDW) model (Agnew et al. 1997).

The results of this evaluation support using the analytical data from the 1997 core samples from tank 241-B-107 as the primary basis for the best-estimate inventory for the following reasons:

- Sampling data, if available, is generally preferable to estimates from tanks with similar wastes or from transfer models.

- The analytical concentrations of components in each of the three waste types now estimated to be in the tank (1C, high aluminum/CW, and BSltCk) generally fall within the ranges observed in other analyses and historical model estimates.

- Based on the analytical results for core 218, the tank layer model (TLM) assumption of 1C solids for the entire tank is incorrect.

Tables 3-1 and 3-2 show the best-basis inventory estimates for tank The inventory estimates for some chemical components are based on the sampling results. For other chemicals, sampling results are partly or entirely based on an engineering estimate derived from the average concentration of components from similar tanks. For others, where no sampling or engineering estimate exists, the HDW model result is used.

Radionuclide inventories were taken from the HDW model estimates because no applicable sample data was available. The inventory values reported in Tables 3-1 and 3-2 are subject to change. Refer to the Tank Characterization Database for the most current inventory values.

Table 3-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-107 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	28,100	S	
Bi	10,600	S	
Ca	547	S	
Cl	997	S	
TIC as CO_3	4,970	E	
Cr	286	S	
F	25,000	S	
Fe	15,900	S	
Hg	52.25	E	Simpson (1998)
K	510	S/E	Engineering estimate for BSltCk was used because the sample result was below detection limits.
La	0	S	Based on process history.
Mn	106	S	

Table 3-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-107 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Na	164,000	S	
Ni	40	S	"Less than" used.
NO_2	3,410	S	
NO_3	151,000	S	
OH_{TOTAL}	46,400	C	
Pb	515	S	
PO_4	76,600	S	
Si	5,850	S	
SO_4	86,700	S	
Sr	121	S	"Less than" used.
TOC	408	E	No high Al/CW or BSltCk data; no estimate for half of tank.
U_{TOTAL}	2,230	S	
Zr	133	S	

Note:

TIC = total inoranic carbon
TOC = total organic carbon

[1]S = sample-based, M = HDW model-based, E = engineering assessment-based, and C = calculated by charge balance; includes oxides as "hydroxide" not including CO_3, NO_2,NO_3, PO_4, SO_4, and SiO_3.

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-107 Decayed to January 1, 1994 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (Ci)[1]	Basis (S, M, or E)[2]	Comment
^{3}H	3.58	E	
^{14}C	0.603	E	Engineering estimate used. "Less than" used in calculation.
^{59}Ni	0.115	E	
^{60}Co	8.17	E	Engineering estimate used. "Less than" used in calculation.
^{63}Ni	10.4	E	
^{79}Se	0.143	E	
^{90}Sr	38,100	E	Engineering estimate used.
^{90}Y	38,100	E	Based on ^{90}Sr.
^{93m}Nb	0.221	E	
^{93}Zr	0.289	E	
^{99}Tc	17.5	E	Engineering estimate used. "Less than" used in calculation.
^{106}Ru	8.43E-05	E	
^{113m}Cd	1.29	E	
^{125}Sb	3.03	E	
^{126}Sn	8.89E-02	E	
^{129}I	7.93	E	
^{134}Cs	3.26	E	
^{137m}Ba	20,500	E	Based on ^{137}Cs.
^{137}Cs	21,700	E	Engineering estimate used.
^{151}Sm	214	E	
^{152}Eu	5.66E-02	E	
^{154}Eu	29.9	E	Engineering estimate used. "Less than" used in calculation.
^{155}Eu	46.2	E	Engineering estimate used. "Less than" used in calculation.
^{226}Ra	7.76E-06	E	
^{227}Ac	9.82E-04	E	
^{228}Ra	1.06E-02	E	

Table 3-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-107 Decayed to January 1, 1994 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (Ci)[1]	Basis (S, M, or E)[2]	Comment
^{229}Th	3.78E-04	E	
^{231}Pa	1.51E-03	E	
^{232}Th	1.28E-03	E	
^{232}U	1.16E-05	S/M	Based on U total; uses HDW isotopic ratios.
^{233}U	1.17E-05	S/M	Based on U total; uses HDW isotopic ratios.
^{234}U	0.735	S/M	Based on U total; uses HDW isotopic ratios.
^{235}U	0.0331	S/M	Based on U total; uses HDW isotopic ratios.
^{236}U	4.69E-03	S/M	Based on U total; uses HDW isotopic ratios.
^{237}Np	1.84E-02	E	
^{238}Pu	0.167	S/M	Based on total alpha; uses HDW isotopic ratios.
^{238}U	0.745	S/M	Based on U total; uses HDW isotopic ratios.
^{239}Pu	52.1	S/M	Based on total alpha; uses HDW isotopic ratios.
^{240}Pu	3.08	S/M	Based on total alpha; uses HDW isotopic ratios.
^{241}Am	0.105	S/M	Based on total alpha; uses HDW isotopic ratios.
^{241}Pu	2.03	S/M	Based on total alpha; uses HDW isotopic ratios.
^{242}Cm	1.19E-04	S/M	Based on total alpha; uses HDW isotopic ratios.
^{242}Pu	6.20E-06	S/M	Based on total alpha; uses HDW isotopic ratios.
^{243}Am	3.95E-07	S/M	Based on total alpha; uses HDW isotopic ratios.
^{243}Cm	2.15E-06	E/M	Based on total alpha; uses HDW isotopic ratios.
^{244}Cm	1.49E-05	E/M	Based on total alpha; uses HDW isotopic ratios.

Notes:

[1]All data except uranium isotopes were derived from other tanks.

[2]S = sample-based, M = HDW model-based, and E = engineering assessment-based

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4.0 RECOMMENDATIONS

All analytical results for the applicable DQOs were well within the safety limits. The safety screening DQO issues (Dukelow et al. 1995) are satisfied with the results of no observed exotherms, flammable gas concentrations measured at 0 and 2 percent of the LFL, and maximum total alpha activity a factor of 400 times lower than the threshold for criticality. Because no exotherms were detected, the memorandum of understanding (Schreiber 1997) indicates that organic complexants are not an issue. Hazardous vapor screening DQO issues (Osborne and Buckley 1995) were addressed by vapor sampling, and no results exceeded the notification limits. The calculated pool size for organic solvents is 12 percent of the limit of concern (Meacham et al. 1997). Sample recovery for core 218 was poor. Nevertheless, sample recovery was judged sufficient to address the issues because all results were far below the action limits.

Table 4-1 summarizes the Project Hanford Management Contractor (PHMC) TWRS Program review status and acceptance of the sampling and analysis results reported in this TCR. All DQO issues required to be addressed by sampling and analysis are listed in column 1 of Table 4-1. Column 2 indicates by "yes" or "no" whether the DQO requirements were met by the sampling and analysis activities performed. Column 3 indicates concurrence and acceptance by the program in PHMC/TWRS that is responsible for the DQO that the sampling and analysis activities performed adequately meet the needs of the DQO. A "yes" or "no" in column 3 indicates acceptance or disapproval of the sampling and analysis information in the TCR.

Table 4-1. Acceptance of Tank 241-B-107 Sampling and Analysis.

Issue	Sampling and Analysis Performed	Program[1] Acceptance
Safety screening DQO	Yes	Yes
Organic complexant MOU	Yes	Yes
Hazardous vapor screening DQO	Yes	Yes
Organic solvents DQO	Yes	Yes

Note:

[1]PHMC TWRS Program Office

Table 4-2 summarizes the status of PHMC TWRS Program review and acceptance of the evaluations and other characterization information contained in this report. The evaluations outlined in this report are the evaluation to determine whether the tank is safe, conditionally safe, or unsafe, and the best-basis inventory evaluation. Column 1 lists the different evaluations performed in this report. Columns 2 and 3 are in the same format as Table 4-1. The manner in which concurrence and acceptance are summarized is also the same as that in Table 4-1. The Tank Data Review Committee reviewed the sampling and analysis results for tank 241-B-107 and concurred that all DQOs had been addressed satisfactorily (Schreiber 1997a).

Table 4-2. Acceptance of Evaluation of Characterization Data and Information for Tank 241-B-107.

Issue	Evaluation Performed	TWRS[1] Program Acceptance
Safety screening analysis	Yes	Yes
Organic complexant analysis (tank is safe)	Yes	Yes
Organic solvents	Yes	Yes

Note:

[1]PHMC TWRS Program Office

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APPENDIX A

HISTORICAL TANK INFORMATION

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APPENDIX A

HISTORICAL TANK INFORMATION

Appendix A describes tank 241-B-107 based on historical information. For this report, historical information includes any information about the fill history, waste types, surveillance, or modeling data about the tank. This information is necessary for providing a balanced assessment of the sampling and analytical results.

This appendix contains the following information:

- **Section A1.0**: Current status of the tank, including the current waste levels and the stabilization and isolation status of the tank
- **Section A2.0**: Information about the tank design
- **Section A3.0**: Process knowledge of the tank; the waste transfer history and the estimated contents of the tank based on modeling data
- **Section A4.0**: Surveillance data for tank 241-B-107, including surface-level readings, temperatures, and a description of the waste surface based on photographs
- **Section A5.0**: Appendix A References

Historical sampling results (results from samples obtained before 1989) are included in Appendix B.

A1.0 CURRENT TANK STATUS

As of September 30, 1997, tank 241-B-107 contained an estimated 625 kL (165 kgal) of noncomplexed waste (Hanlon 1997). The waste volumes were estimated using a manual tape surface-level gauge. Table A1-1 lists the volumes of the waste phases found in the tank.

Tank 241-B-107 was removed from service in 1976 and was declared an assumed leaker in 1980. Primary stabilization (supernatant pumping) was completed in 1979, and the tank was declared interim stabilized in March 1985; intrusion prevention (interim isolation) was completed in October 1985. The tank is passively ventilated and is not on the Watch List (Public Law 101-510).

Table A1-1. Tank Contents Status Summary.[1]

Waste type	kL (kgal)
Total waste	625 (165)
Supernatant	4 (1)
Sludge	621 (164)
Saltcake	0 (0)
Drainable interstitial liquid	45 (12)
Drainable liquid remaining	49 (13)
Pumpable liquid remaining	26 (7)

Note:

[1]Hanlon (1997)

A2.0 TANK DESIGN AND BACKGROUND

Tank 241-B-107 was constructed during 1943 and 1944. It is one of twelve 2,010 kL (530 kgal) tanks in B Tank Farm. These tanks were designed for nonboiling waste with a maximum fluid temperature of 104 °C (220 °F) (Leach and Stahl 1997). Tank 241-B-107 has 11 risers ranging in size from 10 cm (4 in.) to 1.1 m (42 in.) in diameter that provide surface-level access to the underground tank. There is one riser through the center of the tank dome and five each on opposite sides of the dome.

Tank 241-B-107 entered service in 1945 and is the first in a three-tank cascading series. These tanks are connected by a 7.6 cm (3 in.) cascade line. The cascade overflow height is approximately 4.78 m (188 in.) from the tank bottom and 60 cm (2 ft) below the top of the steel liner. These single-shell tanks are constructed of 30-cm (1-ft)-thick reinforced concrete with a 6.4 mm (1/4 in.) mild carbon steel liner on the bottom and sides and a 38-cm (1.25-ft)-thick domed concrete top. These tanks have a dished bottom with a 1.2 m (4 ft) radius knuckle and a 5.18 m (17 ft) operating depth. The tanks are set on a reinforced concrete foundation. Each tank in the B Tank Farm was covered with at least 1.5 m (5 ft) of overburden.

Figure A2-1 is a plan view of the riser configuration. The surface level is monitored through riser 8 with a manual tape surface-level gauge. Riser 3 contains a thermocouple tree. Tank 241-B-107 has four process inlet nozzles and one cascade overflow outlet. Table A2-1 lists tank 241-B-107 risers, their sizes, and general uses.

Figure A2-2 shows a tank cross section with the approximate waste level and a schematic of the tank equipment Tank 241-B-107 has 11 risers. Risers 2, 6, and 7 are tentatively available for sampling (Lipnicki 1997). Risers 2 and 6 are 30 cm (12 in.) in diameter, and riser 7 is 10 cm (4 in.) in diameter. Riser 2 is on the opposite side of the tank from risers 6 and 7.

Table A2-1. Tank 241-B-107 Risers.[1]

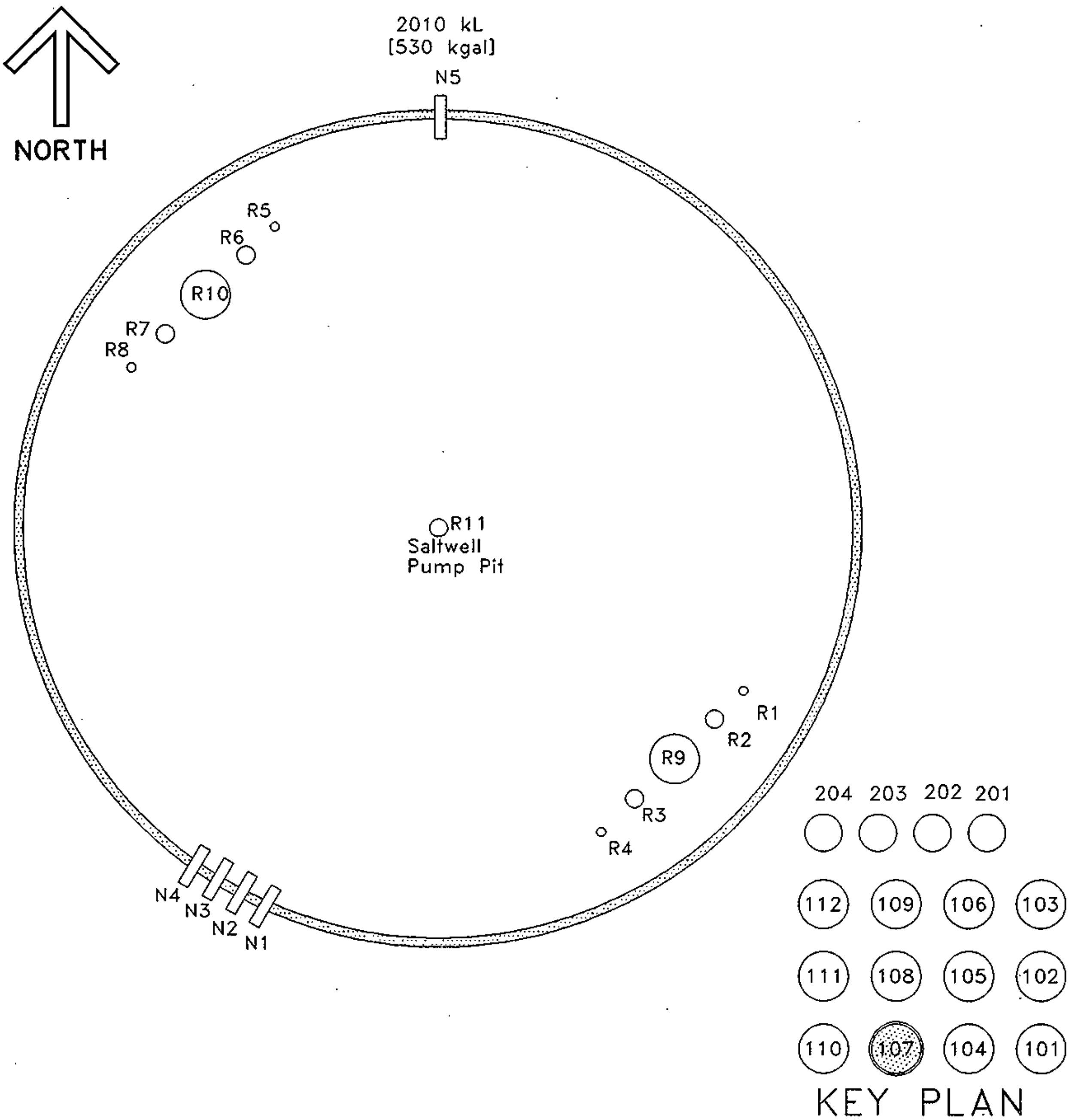
Number	Diameter (in.)	Description and Comments
R1	4	Blind flange, weather covered
R2[2]	12	B-222 observation port
R3	12	Thermocouple tree
R4	4	Breather filter [Benchmark Change Engineering Order-37777] December 8, 1986
R5	4	Blind flange
R6[2]	12	Sludge measurement port
R7[2]	12	Flange
R8	4	Liquid level reel [Benchmark Change Engineering Order-37777] December 8, 1986
R9	42	Manhole, below grade
R10	42	Manhole, below grade
R11	12	Salt well screen, weather covered
N1	3	Spare
N2	3	Spare
N3	3	Spare
N4	3	Spare
N5	3	Overflow

Notes:

[1]Alstad (1993),.Tran (1993), and Vitro (1986)

[2]Denotes risers tentatively available for sampling (Lipnicki 1997).

Figure A2-1. Riser Configuration for Tank 241-B-107.



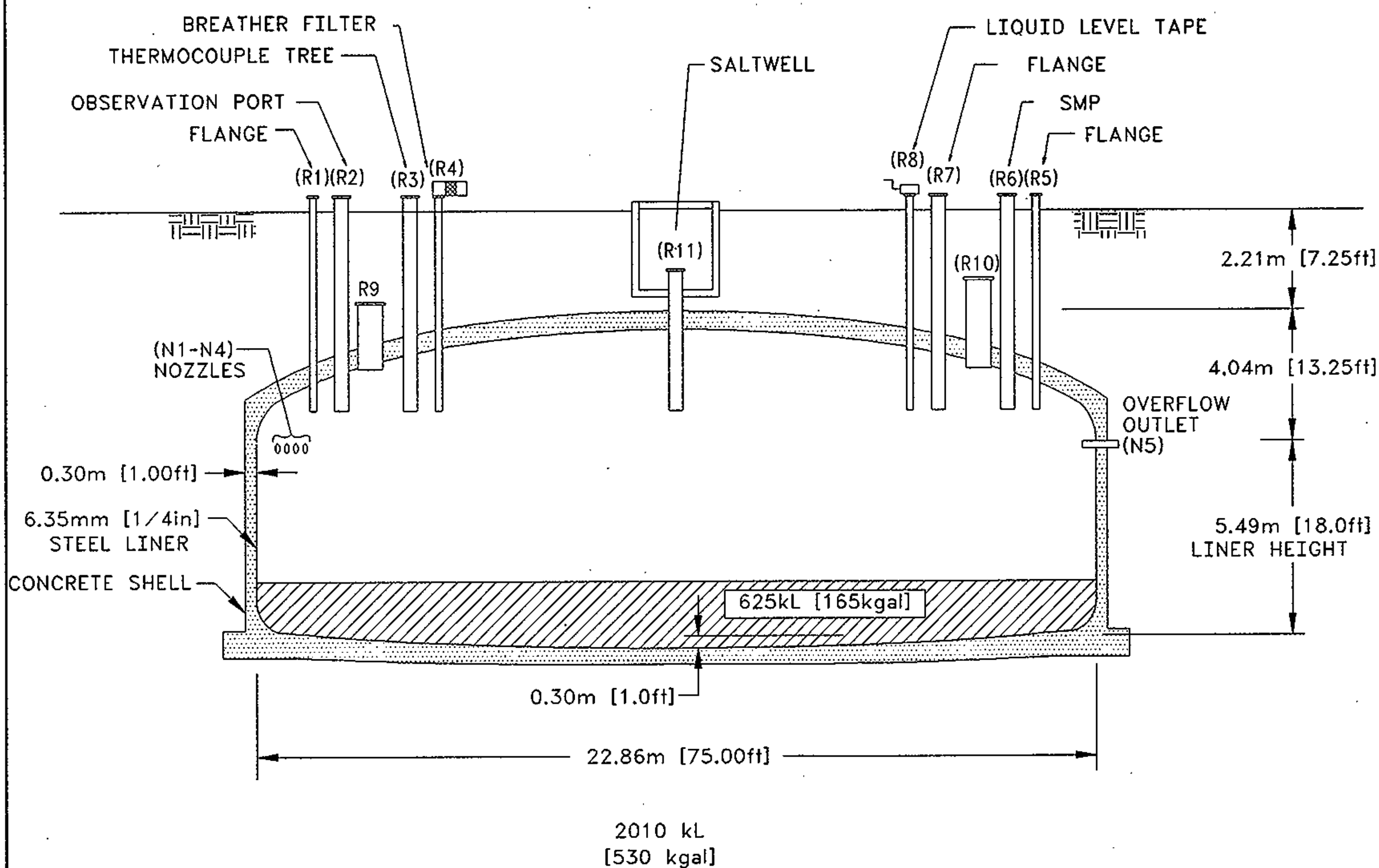


Figure A2-2. Tank 241-B-107 Cross Section and Schematic.

A3.0 PROCESS KNOWLEDGE

The sections below 1) provide information about the transfer history of tank 241-B-107, 2) describe the process wastes that made up the transfers, and 3) give an estimate of the current tank contents based on transfer history.

A3.1 WASTE TRANSFER HISTORY

Table A3-1 summarizes the waste transfer history of tank 241-B-107 (Agnew et al. 1997b). Waste was initially added to tank 241-B-107 in the second quarter of 1945 consisting of first cycle decontamination (1C) waste from the bismuth phosphate process. By the end of 1945, tank 241-B-107 was filled and began to cascade to tank 241-B-108. Tank 241-B-107 continued to receive 1C waste and cascade to tank 241-B-108 until the second quarter of 1946.

From the first quarter of 1952 to the fourth quarter of 1954, waste was transferred from tank 241-B-107 into and was received from tank 241-B-106. In the third quarter of 1954, supernatant waste from tank 241-B-107 was transferred to a crib. In the third quarter of 1957, waste was transferred to tank 241-C-109 for ferrocyanide scavenging.

From the third to the fourth quarter of 1963, tank 241-B-107 received PUREX cladding waste from PUREX, tanks 241-C-101, 241-C-102, 241-C-103, and 241-C-106. During this same period, some waste cascaded to tank 241-B-108. In the third quarter of 1969, approximately two-thirds of the waste in the tank was sent to tank 241-B-103. From the second quarter of 1972 to the second quarter of 1976, the tank received flush water and supernatant waste was sent to tank 241-B-102.

Table A3-1. Tank 241-B-107 Major Transfers.[1,2] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
B Plant	--	1C	1945 - 1946	6,020	1,590
--	241-B-108	1C	1945 - 1946	-4,010	-1,060
241-B-106	--	Sludge	1952 - 1954	3,400	897
--	241-B-106	Supernatant	1952 - 1953	-2,340	-617
--	B-037 crib	Supernatant	1954	-1,220	-322
--	241-C-109	TFeCN	1957	-920	-242

Table A3-1. Tank 241-B-107 Major Transfers.[1,2] (2 sheets)

Transfer Source	Transfer Destination	Waste Type	Time Period	Estimated Waste Volume	
				kL	kgal
PUREX 241-C-101 241-C-102 241-C-103 241-C-106	--	PUREX cladding waste	1963	5,280	1,395
--	241-B-108	Supernatant	1963	-4,300	-1,136
--	241-B-103	Supernatant	1969	-1,240	-327
Miscellaneous sources	--	Flush water	1972, 1974	23	6
--	241-B-102	Supernatant	1972 - 1976	-178	-47

Notes:

[1]Agnew et al. 1997b

[2]Because only major transfers are listed, the sum of these transfers will not equal the current tank waste volume.

A3.2 HISTORICAL ESTIMATION OF TANK CONTENTS

The historical transfer data used for this estimate are from the following sources:

- *Waste Status and Transaction Record Summary (WSTRS Rev. 4)* (Agnew et al. 1997b). The summary is a tank-by-tank quarterly summary spreadsheet of waste transactions.

- *Hanford Tank Chemical and Radionuclide Inventories: HDW Model Rev. 4* (Agnew et al. 1997a). This document contains the HDW list, the supernatant mixing model (SMM), TLM, and the historical tank inventory estimates.

- The HDW list is comprised of approximately 50 waste types defined by concentration for major analytes/compounds for both sludge and supernatant layers.

- The TLM defines the sludge and saltcake layers in each tank using waste composition and waste transfer information.

- The SMM is a subroutine within the HDW model that calculates the volume and composition of certain supernatant blends and concentrates.

Using these records, the TLM defines the sludge and saltcake layers in each tank. The SMM uses information from the WSTRS, the TLM, and the HDW list to describe the supernatants and concentrates in each tank. Together the WSTRS, TLM, SMM, and HDW list determine each tank's inventory estimate. These model predictions are considered estimates that require further evaluation using analytical data.

Based on Agnew et al. (1997a), tank 241-B-107 contains a 4 kL (1 kgal) supernatant layer over a 622 kL (164 kgal) layer of first cycle decontamination waste (1C). The 1C layer is expected to contain above 1 weight percent of sodium, aluminum, iron, hydroxide, nitrate, phosphate, and uranium. Figure A3-1 is a graph representing the estimated waste type and volume for the tank layer. Tables A3-2 and A3-3 show the historical estimate of the expected waste constituents and their concentrations for chemical constituents and radionuclides, respectively.

It should be noted that these estimates were generated before sampling. Based on sampling results, the tank appears to contain saltcake and cladding waste as well (see Appendix D).

Figure A3-1. Tank Layer Model.

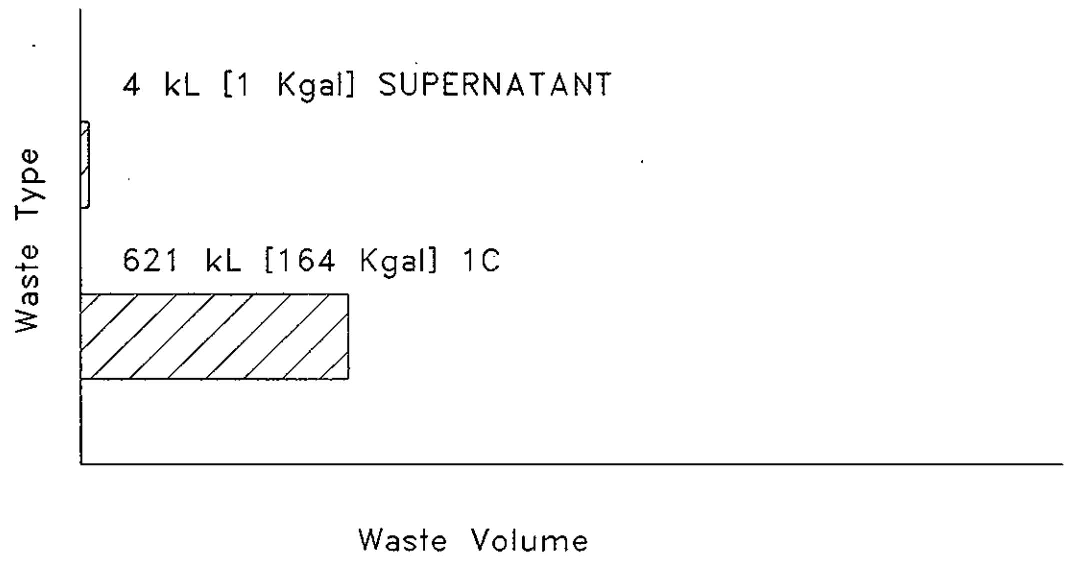


Table A3-2. Historical Tank Inventory Estimate (Chemicals).[1, 2] (2 sheets)

Total Inventory Estimate					
Physical Properties				**-95 CI**	**+95 CI**
Total waste	8.61E+05 (kg) (165 kgal)			--	--
Heat load	5.69E-02 (kW) (194 Btu/hr)			4.52E-02	6.90E-02
Bulk density[3]	1.38 (g/cm^3)			1.28	1.44
Water wt%[3]	64.2			60.2	70.7
TOC wt% C (wet)[3]	1.26E-05			8.47E-06	1.68E-05
Chemical Constituents	***M***	**μg/g**	**kg**[4]	**-95 CI (*M*)**	**+95 CI (*M*)**
Na^+	5.20	8.67E+04	7.46E+04	3.28	6.46
Al^{3+}	0.596	1.17E+04	1.00E+04	0.595	0.596
Fe^{3+} (total Fe)	0.350	1.42E+04	1.22E+04	0.344	0.356
Cr^{3+}	4.83E-03	182	157	3.84E-03	5.86E-03
Bi^{3+}	6.20E-02	9.40E+03	8.09E+03	4.92E-02	6.88E-02
La^{3+}	0	0	0	0	0
Hg^{2+}	1.05E-04	15.3	13.2	7.31E-05	1.22E-04
Zr (as $ZrO(OH)_2$)	2.38E-04	15.7	13.5	1.89E-04	2.88E-04
Pb^{2+}	1.94E-06	0.291	0.251	1.24E-06	2.64E-06
Ni^{2+}	1.19E-03	50.7	43.6	9.46E-04	3.40E-03
Sr^{2+}	0	0	0	0	0
Mn^{4+}	0	0	0	0	0
Ca^{2+}	7.58E-02	2.20E+03	1.90E+03	4.71E-02	9.78E-02
K^+	6.69E-03	190	163	5.31E-03	8.11E-03
OH^-	4.04	4.99E+04	4.29E+04	3.95	4.10
NO_3^-	1.03	4.63E+04	3.99E+04	0.858	1.19
NO_2^-	0.235	7.84E+03	6.75E+03	0.148	0.344
CO_3^{2-}	7.58E-02	3.30E+03	2.84E+03	4.71E-02	9.78E-02
PO_4^{3-}	1.14	7.88E+04	6.79E+04	0.668	1.40
SO_4^{2-}	5.17E-02	3.60E+03	3.10E+03	4.11E-02	6.27E-02
Si (as SiO_3^{2-})	0.222	4.53E+03	3.90E+03	0.114	0.328
F^-	0.138	1.90E+03	1.64E+03	0.110	0.321
Cl^-	3.08E-02	791	681	2.44E-02	3.73E-02
citrate^{3-}	0	0	0	0	0
$EDTA^{4-}$	0	0	0	0	0
$HEDTA^{3-}$	0	0	0	0	0

Table A3-2. Historical Tank Inventory Estimate (Chemicals).[1, 2] (2 sheets)

Total Inventory Estimate					
Physical Properties				-95 CI	+95 CI
Chemical Constituents	*M*	$\mu g/g$	kg[4]	-95 CI (*M*)	+95 CI (*M*)
glycolate$^-$	0	0	0	0	0
acetate$^-$	0	0	0	0	0
oxalate^{2-}	0	0	0	0	0
DBP	1.21E-06	0.184	0.159	8.11E-07	1.61E-06
butanol	1.21E-06	6.50E-02	5.60E-02	8.11E-07	1.61E-06
NH_3	7.89E-02	973	838	6.41E-02	9.34E-02
$Fe(CN)_6^{4-}$	0	0	0	0	0

Notes:

CI = confidence interval

[1]Agnew et al. (1997a)

[2]The historical tank inventory estimate predictions have not been validated and should be used with caution.

[3]Water wt% was derived from the difference of density and total dissolved species.

[4]Differences exist among the inventories in this column and the inventories calculated from the two sets of concentrations.

Table A3-3. Historical Tank Inventory Estimate (Radionuclides).[1, 2] (2 sheets)

Total Inventory Estimate				
Physical Properties			-95 CI	+95 CI
Total waste	8.61E+05 (kg)	(165 kgal)	--	--
Heat load	5.69E-02 (kW)	(194 Btu/hr)	4.52E-02	6.90E-02
Bulk density[3]	1.38 (g/cm^3)		1.28	1.44
Water wt%[3]	64.2		60.2	70.7
TOC wt% C (wet)[3]	1.26E-05		8.47E-06	1.68E-05

Table A3-3. Historical Tank Inventory Estimate (Radionuclides).[1,2] (2 sheets)

Radiological Constituents	Ci/L	μCi/g	Ci[4]	-95 CI (Ci/L)	+95 CI (Ci/L)
^{3}H	3.43E-07	2.49E-04	0.214	2.04E-07	5.23E-07
^{14}C	8.78E-08	6.37E-05	5.48E-02	7.01E-08	1.06E-07
^{59}Ni	2.48E-08	1.80E-05	1.55E-02	1.97E-08	7.03E-08
^{63}Ni	2.18E-06	1.58E-03	1.36	1.73E-06	6.17E-06
^{60}Co	1.34E-08	9.74E-06	8.39E-03	1.10E-08	1.60E-08
^{79}Se	1.83E-08	1.33E-05	1.15E-02	1.46E-08	2.22E-08
^{90}Sr	7.57E-03	5.49	4.73E+03	6.01E-03	9.17E-03
^{90}Y	7.57E-03	5.49	4.73E+03	6.02E-03	9.18E-03
^{93}Zr	8.75E-08	6.35E-05	5.46E-02	6.97E-08	1.06E-07
^{93m}Nb	7.52E-08	5.46E-05	4.70E-02	5.99E-08	9.10E-08
^{99}Tc	6.07E-07	4.41E-04	0.379	4.85E-07	7.34E-07
^{106}Ru	3.17E-13	2.30E-10	1.98E-07	1.48E-13	4.87E-13
^{113m}Cd	1.81E-07	1.32E-04	0.113	1.45E-07	2.19E-07
^{125}Sb	1.13E-08	8.21E-06	7.07E-03	9.96E-09	1.27E-08
^{126}Sn	2.73E-08	1.98E-05	1.70E-02	2.17E-08	3.30E-08
^{129}I	1.13E-09	8.21E-07	7.07E-04	9.04E-10	1.37E-09
^{134}Cs	3.23E-10	2.34E-07	2.02E-04	2.51E-10	3.96E-10
^{137}Cs	8.56E-03	6.21	5.35E+03	6.81E-03	1.04E-02
^{137m}Ba	8.10E-03	5.88	5.06E+03	6.44E-03	9.81E-03
^{151}Sm	6.93E-05	5.03E-02	43.3	5.52E-05	8.38E-05
^{152}Eu	8.61E-09	6.24E-06	5.38E-03	8.45E-09	8.77E-09
^{154}Eu	1.88E-07	1.36E-04	0.118	1.55E-07	2.22E-07
^{155}Eu	1.28E-06	9.31E-04	0.802	1.26E-06	1.31E-06
^{226}Ra	7.74E-12	5.61E-09	4.83E-06	6.15E-12	9.38E-12
^{228}Ra	1.48E-12	1.07E-09	9.22E-07	4.18E-13	2.55E-12

Table A3-3. Historical Tank Inventory Estimate (Radionuclides).[1, 2] (2 sheets)

Radiological Constituents	Ci/L	μCi/g	Ci[4]	-95 CI (Ci/L)	+95 CI (Ci/L)
^{227}Ac	3.93E-11	2.85E-08	2.46E-05	3.13E-11	4.76E-11
^{231}Pa	8.33E-11	6.04E-08	5.20E-05	6.66E-11	1.01E-10
^{229}Th	6.90E-13	5.01E-10	4.31E-07	2.11E-13	1.18E-12
^{232}Th	3.16E-12	2.29E-09	1.97E-06	8.94E-13	5.45E-12
^{232}U	2.50E-10	1.81E-07	1.56E-04	2.27E-10	2.56E-10
^{233}U	2.52E-10	1.82E-07	1.57E-04	1.63E-10	2.76E-10
^{234}U	1.59E-05	1.15E-02	9.90	1.49E-05	1.64E-05
^{235}U	7.13E-07	5.17E-04	0.445	6.68E-07	7.37E-07
^{236}U	1.01E-07	7.34E-05	6.32E-02	9.49E-08	1.05E-07
^{238}U	1.61E-05	1.16E-02	10.0	1.50E-05	1.66E-05
^{237}Np	3.62E-09	2.63E-06	2.26E-03	2.89E-09	4.38E-09
^{238}Pu	5.35E-08	3.88E-05	3.34E-02	1.93E-08	1.82E-07
^{239}Pu	1.67E-05	1.21E-02	10.4	5.98E-06	5.69E-05
^{240}Pu	9.85E-07	7.14E-04	0.615	3.54E-07	3.35E-06
^{241}Pu	6.49E-07	4.71E-04	0.405	2.45E-07	2.17E-06
^{242}Pu	1.98E-12	1.44E-09	1.24E-06	7.48E-13	6.62E-12
^{241}Am	3.35E-08	2.43E-05	2.09E-02	2.74E-08	3.99E-08
^{243}Am	1.26E-13	9.16E-11	7.89E-08	1.09E-13	1.44E-13
^{242}Cm	3.80E-11	2.76E-08	2.38E-05	3.68E-11	3.93E-11
^{243}Cm	6.87E-13	4.98E-10	4.29E-07	6.11E-13	7.64E-13
^{244}Cm	4.76E-12	3.45E-09	2.97E-06	3.69E-12	5.84E-12
Totals	**M**	**μg/g**	**kg[4]**	**-95 CI (M or g/L)**	**+95 CI (M or g/L)**
Pu	2.73E-04 (g/L)	----	0.170	9.77E-05	9.30E-04
U	0.202	3.49E+04	3.00E+04	0.189	0.209

Notes:

[1]Agnew et al. (1997a)

[2]The historical tank inventory estimate predictions have not been validated and should be used with caution.

[3]Water wt% was derived from the difference of density and total dissolved species.

[4]Differences exist among the inventories in this column and the inventories calculated from the two sets of concentrations.

A4.0 SURVEILLANCE DATA

Tank 241-B-107 surveillance consists of surface-level measurements (liquid and solid), temperature monitoring inside the tank (waste and headspace), and leak detection well (dry well) monitoring for radioactivity outside the tank. Surveillance data provide the basis for determining tank integrity.

Liquid-level measurements can indicate whether the tank has a major leak. Solid surface-level measurements provide an indication of physical changes in and consistencies of the solid layers of a tank. Dry wells located around the tank perimeter may show increased radioactivity caused by leaks.

A4.1 SURFACE-LEVEL READINGS

Tank 241-B-107 is categorized as an assumed leaker. A manual tape in riser 8 is used to measure the surface level in the tank. The manual tape reading on October 16, 1997, was 138.43 cm (54.5 in.) (LMHC 1997). Figure A4-1 is a level history graph of the volume measurements.

Tank 241-B-107 has no liquid observation well; it does have four identified dry wells. One dry well has had readings greater than 200 counts/second.

A4.2 INTERNAL TANK TEMPERATURES

Tank 241-B-107 has a single thermocouple tree with 12 thermocouples to monitor the waste temperature through riser 3. Temperature readings are available from the Surveillance Analysis Computer System from May 1975 to January 1982 and semiannually from November 1991 to July 1997 (LMHC 1997).

The average tank temperature is 18.2 °C (64.7 °F), the minimum temperature is 10 °C (50 °F), and the maximum temperature is 30.5 °C (87 °F). Plots of the thermocouple readings are available in the *Supporting Document for the Historical Tank Content Estimate for B-Tank Farm* (Brevick et al. 1997). Figure A4-2 shows a graph of the weekly high temperature.

Figure A4-1. Tank 241-B-107 Level History.

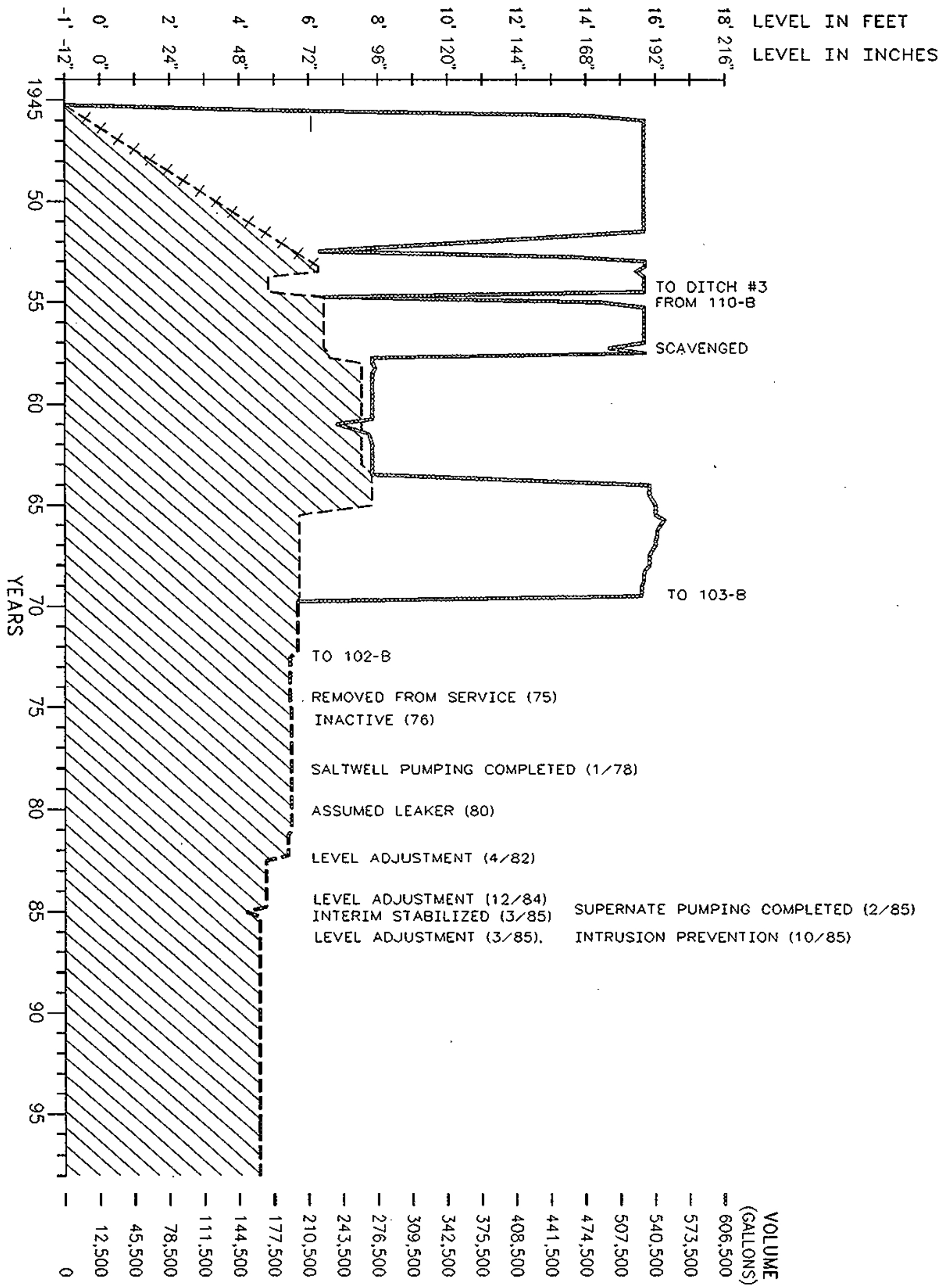
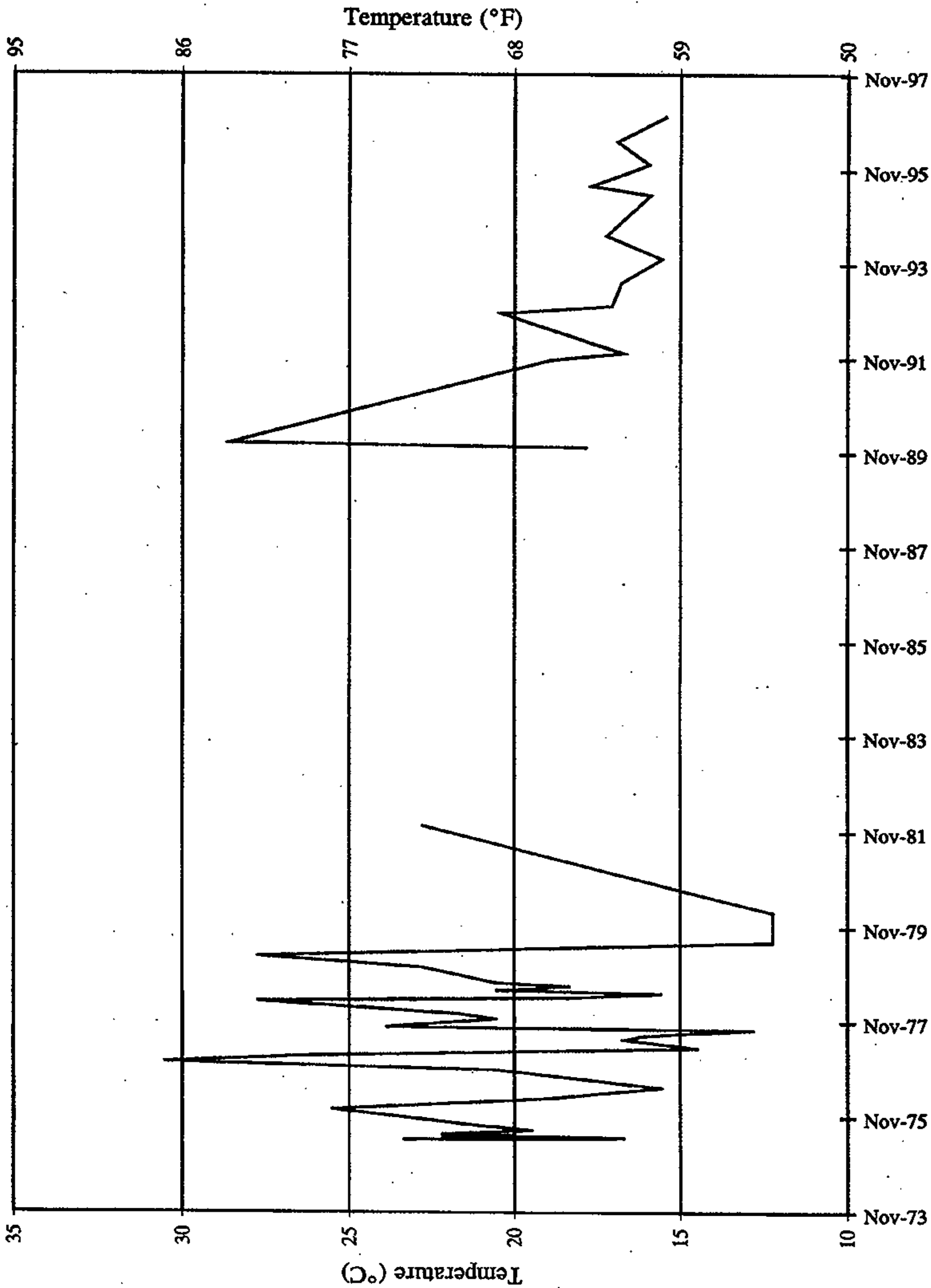


Figure A4-2. Tank 241-B-107 High Temperature Plot.



A4.3 TANK 241-B-107 PHOTOGRAPHS

From the February 1985 photograph (Brevick et al. 1997), the surface of the waste appears to be an off-white, dry to dark brown, wet sludge surface. A white saltcake ring is evident around the interior sides of the tank just above the waste surface. Various equipment are visible in the photographs. Because no change in tank level has occurred since the photographs were taken, the picture should represent existing tank contents.

A5.0 APPENDIX A REFERENCES

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APPENDIX B

SAMPLING OF TANK 241-B-107

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APPENDIX B

SAMPLING OF TANK 241-B-107

Appendix B provides sampling and analysis information for each known sampling event for tank 241-B-107 and assesses the core sample results. It includes the following.

- **Section B1.0**: Tank Sampling Overview
- **Section B2.0**: Sampling Events
- **Section B3.0**: Assessment of Characterization Results
- **Section B4.0**: Appendix B References

Future sampling information for tank 241-B-107 will be appended to the above list.

B1.0 TANK SAMPLING OVERVIEW

This section describes the sampling and analysis data for tank 241-B-107. Section B2.0 describes the sampling and analysis events associated with tank 241-B-107. Core samples were taken in September 1997 to satisfy the requirements of the *Tank Safety Screening Data Quality Objective* (Dukelow et al. 1995) and the *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements* (Schreiber 1997). The sampling and analyses were performed in accordance with the *Tank 241-B-107 Push Mode Core Sampling and Analysis Plan* (Conner 1997). Further discussions of the sampling and analysis procedures are available in the *Tank Characterization Reference Guide* (DeLorenzo et al. 1994). Section B2.1 discusses the 1997 core sampling event. Section B2.2 discusses vapor sampling A solid sample was also taken from this tank in January 1976; Section B2.3 discusses the analysis Sections B2.4, B2.5, and B2.6 contain the data tables for the core samples, vapor samples, and historical samples, respectively.

In-situ vapor samples taken in July 1996 were analyzed to address the *Data Quality Objective for Tank Hazardous Vapor Safety Screening* (Osborne and Buckley 1995). Osborne and Buckley also address the results of combustible gas meter measurements in the tank headspace. Section B3.0 assesses characterization results, focusing on the core sample data. It also discusses sampling issues and laboratory quality control and data consistency, and it provides a statistical analysis of the data.

B2.0 DESCRIPTION OF SAMPLING EVENTS

This section discusses the core samples and vapor samples that were taken from tank 241-B-107.

B2.1 1997 CORE SAMPLING EVENT

Two push mode core samples were collected from tank 241-B-107. Core 217 was obtained from riser 6 on September 5 and 8, and core 218 was obtained from riser 2 on September 9 and 10. All samples were extruded by the 222-S Laboratory on September 17, 1997 (Nuzum 1997).

The core samples were analyzed to address the issues in the safety screening DQO (Dukelow et al. 1995) and the organic complexant memorandum of understanding (Schreiber 1997). Table B2-1 summarizes the sampling and analytical requirements.

Table B2-1. Core Sampling Data Quality Objective Requirements for Tank 241-B-107.[1]

Sampling Event	Applicable DQOs	Sampling Requirements	Analytical Requirements
Push mode core sampling	Safety screening - Energetics - Moisture content - Total alpha - Flammable gas Dukelow et al. (1995)	Core samples from a minimum of two risers separated radially to the maximum extent possible.	Flammability, energetics, moisture, total alpha activity, density, anions, cations
	Organic complexants Schreiber (1997)	Combustible gas measurement	

Note:
[1]Conner 1997

B2.1.1 Sample Handling

Table B2-2 shows subsampling details. Sample recovery for core 217 was good, but it was poor for core 218 where the samples had a large amount of liner liquid. The poor recovery for core 218 is discussed in Section B3.1.

Table B2-2. Tank 241-B-107 Subsampling Scheme and Sample Description.[1]

Core - Segment	Liquid		Solids		Recovery (%)	Sample Characteristics
	LL[2] (mL)	DL (g)	UH (g)	LH (g)		
217-1	<5	-	155.6	122.4	100	Lower half solids were brown and resembled a wet salt. Large salt crystals were present. Upper half solids were brown with a white paste center and resembled a wet sludge.
217-2	>3.5	32.6	165.3	184.0	97	Drainable liquid was brown and opaque. No organic layer was present. Lower half solids were yellowish green and resembled a wet sludge. Upper half solids were yellowish green to brown and resembled a wet sludge.
217-3	60	30.5	108.7	195.2	84	Drainable liquid was yellowish brown and opaque. No organic layer was present.. Lower half solids were yellowish green and resembled a wet sludge. Upper half solids were brown and resembled a sludge slurry.
218-1	30	-	11.5	-	12	Solids were gray and resembled dry salt
218-2	100	-	106.8	-	21	Solids were reddish brown and resembled wet sludge
218-3	200	-	-	-	0	No sample
218-4	200	91.5	19.6	-	26	Drainable liquid was brown and opaque. No organic layer was present. Solids were brown and resembled wet salt.

Notes:

DL = drainable liquid
LH = lower half
LL = liner liquid
UH = upper half

[1]Nuzum (1997)
[2]Griffin (1997)

B2.1.2 Sample Analysis

The analyses performed on the core samples were limited to those required by the safety screening DQO, the organic complexant memorandum of understanding, and for process control. The safety screening DQO required analyses for thermal properties by DSC, moisture content by thermogravimetric analysis (TGA), and content of fissile material by total alpha activity analysis. The memorandum of understanding required analysis for thermal properties by DSC and moisture content by TGA. Process control required analyses of metals by ICP (inductively coupled plasma) and anions by IC to determine the extent of intrusion by hydrostatic head fluid (HHF).

Differential scanning calorimetry and TGA were performed on small subsamples (less than 50 mg). Quality control (QC) tests included performing the analyses in duplicate and using standards.

Bulk density (mass divided by volume) was calculated after centrifuging a known mass of sample (approximately 10 g) in a graduated centrifuge cone. Specific gravity was calculated after pipetting a known volume of liquid into a tared vial, then dividing the calculated density of the sample by the density of water at a specified temperature.

Total alpha activity measurements were performed on samples that had been fused in a solution of potassium hydroxide, then dissolved in acid. The resulting solution was dried on a counting planchet and counted in an alpha proportional counter. Quality control tests included standards, spikes, blanks, and duplicate analyses.

Ion chromatography (IC) was performed on samples that had been prepared by water digestion. Quality control tests included standards, spikes, blanks, and duplicate analyses. The sampling and analysis plan (SAP) required measuring the full suite of IC analytes.

Inductively coupled plasma spectrometry was performed on samples that had been prepared by acid digestion. Quality control tests included standards, blanks, spikes, and duplicate analyses. The SAP required analyzing the full suite of ICP elements.

All reported analyses were performed according to approved laboratory procedures. Table B2-3 lists procedure numbers and applicable analyses.

Table B2-4 summarizes sample numbers and analyses performed on each subsample.

Table B2-3. Analytical Procedures.[1]

Analysis	Method	Procedure Number
Energetics	DSC	LA-514-114
Percent water	TGA	LA-514-114
Total alpha activity	Alpha proportional counter	LA-508-101
Flammable gas	Combustible gas analyzer	WHC-IP-0030 IH 1.4 and IH-2.1[2]
Metals by ICP/AES	Inductively coupled plasma spectrometer	LA-505-151 LA-505-161
Anions by IC	Ion chromatograph	LA-533-105
Specific gravity	Gravimetry	LA-510-112
Bulk density	Gravimetry	LO-160-103

Notes:

ICP\AES = inductively coupled plasma/atomic emission spectroscopy

[1]Nuzum (1997)

[2]WHC (1992). Safety Department Administrative Manuals, Westinghouse Hanford Company, Richland, Washington:

IH 1.4, Industrial Hygiene Direct Reading Instrument Survey

IH 2.1, Standard Operating Procedure, MSA Model 260 Combustible Gas and Oxygen Analyzer

Table B2-4. Analyses by Sample Number for Tank 241-B-107 Core Samples. (3 sheets)

Sample ID	Sample Portion	Sample Number	Analyses
217-1	Upper half solids	S97T002062	Bulk density
		S97T002071	DSC, TGA
		S97T002090	Total alpha
		S97T002091	ICP
		S97T002092	IC
	Lower half solids	S97T002061	Bulk density
		S97T002069	DSC, TGA
		S97T002087	Total alpha
		S97T002088	ICP
		S97T002089	IC

Table B2-4. Analyses by Sample Number for Tank 241-B-107 Core Samples. (3 sheets)

Sample ID	Sample Portion	Sample Number	Analyses
217-2	Upper half solids	S97T002064	Bulk density
		S97T002075	DSC, TGA
		S97T002096	Total alpha
		S97T002097	ICP
		S97T002098	IC
	Lower half solids	S97T002063	Bulk density
		S97T002073	DSC, TGA
		S97T002093	Total alpha
		S97T002094	ICP
		S97T002095	IC
	Drainable liquid	S97T002077	DSC, TGA, specific gravity, total alpha
		S97T002078	ICP, IC
217-3	Upper half solids	S97T002067	Bulk density
		S97T002082	DSC, TGA
		S97T002102	Total alpha
		S97T002103	ICP
		S97T002104	IC
	Lower half solids	S97T002066	Bulk density
		S97T002080	DSC, TGA
		S97T002099	Total alpha
		S97T002100	ICP
		S97T002101	IC
	Drainable liquid	S97T002084	DSC, TGA, specific gravity, total alpha
218-1	Upper half solids	S97T002109	DSC, TGA
		S97T002117	ICP
		S97T002118	IC

Table B2-4. Analyses by Sample Number for Tank 241-B-107 Core Samples. (3 sheets)

Sample ID	Sample Portion	Sample Number	Analyses
218-2	Upper half solids	S97T002106	Bulk density
		S97T002110	DSC, TGA
		S97T002119	Total alpha
		S97T002120	ICP
		S97T002121	IC
218-4	Upper half solids	S97T002107	Bulk density
		S97T002112	DSC, TGA
		S97T002122	Total alpha
		S97T002123	ICP
		S97T002124	IC
	Drainable liquid	S97T002114	DSC, TGA, Specific gravity, total alpha
		S97T002115	ICP, IC

B2.1.3 Analytical Results

This section summarizes the sampling and analytical results associated with the September 1997 sampling and analysis of tank 241-B-107. Because of the large amount of data, the core sampling results are provided in Section B2.4. Table B2-5 shows location of the total alpha activity, percent water, bulk density, specific gravity, IC, and ICP analytical results associated with the 1997 core samples from this tank. These results are documented in Nuzum (1997).

Table B2-5. 1997 Core Sample Analytical Tables.

Analysis	Table Number
Total alpha activity	B2-58
Percent water	B2-56
Summary data for metals by ICP	B2-10 through B2-46
Anions by IC	B2-47 through B2-54
Bulk density	B2-55
Specific gravity	B2-57

The four QC parameters assessed in conjunction with tank 241-B-107 samples were standard recoveries, spike recoveries, duplicate analyses (relative percent differences [RPDs]), and blanks. The QC criteria are specified in the SAP (Conner 1997). The only QC parameter for which limits are not specified in the SAP is blank contamination. The limits for blanks are set forth in guidelines followed by the laboratory (Markel 1997), and all data results in this report have met those guidelines. Sample and duplicate pairs, in which any QC parameter was outside these limits, are footnoted in the sample mean column of the data summary tables with an a, b, c, d, or e as follows.

- "a" indicates the standard recovery was below the QC limit.
- "b" indicates the standard recovery was above the QC limit.
- "c" indicates the spike recovery was below the QC limit.
- "d" indicates the spike recovery was above the QC limit.
- "e" indicates the RPD was above the QC limit.
- "f" indicates blank contamination.

In the analytical tables in this section, the "mean" is the average of the result and duplicate value. All values, including those below the detection level (denoted by "<") were averaged. If both sample and duplicate values were non-detected or if one value was detected while the other was not, the mean is expressed as a non-detected value. If both values were detected, the mean is expressed as a detected value.

B2.1.3.1 Total Alpha Activity. Analyses for total alpha activity were performed on the samples recovered from tank 241-B-107. The samples were prepared by fusion digestion. Two fusions were prepared for each sample (for duplicate results). Each fused dilution was analyzed twice, and the results were averaged and reported as one value. The highest result returned was 0.0853 μCi/g.

B2.1.3.2 Thermogravimetric Analysis. Thermogravimetric analysis measures the mass of a sample as its temperature is increased at a constant rate. Nitrogen is passed over the sample during heating to remove any released gases. A decrease in the weight of a sample during TGA represents a loss of gaseous matter from the sample, through evaporation or through a reaction that forms gas phase products. The moisture content is estimated by assuming that all TGA sample weight loss up to a certain temperature (typically 105 to 200 °C [220 to 390 °F]) is caused by water evaporation. The temperature limit for moisture loss is chosen by the operator at an inflection point on the TGA plot. Other volatile matter fractions can often be differentiated by inflection points as well.

The TGA results typically ranged from 30 to 50 percent for solids. The exception was the upper half subsample from segment 218-1 which measured only 5.78 percent water.

B2.1.3.3 Differential Scanning Calorimetry. In a DSC analysis, heat absorbed or emitted by a substance is measured while the sample is heated at a constant rate. Nitrogen is passed over the sample material to remove any gases being released. The onset temperature for an endothermic or exothermic event is determined graphically.

The DSC analyses for tank 241-B-107 were performed using a DSC instrument. No exothermic reactions were noted; therefore, an upper limit of a 95 percent confidence interval (CI) on the mean for each sample was not calculated, and no data table is provided for the DSC results. The DSC scans can be found in the data package (Nuzum 1997).

B2.1.3.4 Inductively Coupled Plasma. Samples were prepared by acid digest. Although a full suite of analytes were reported, only lithium was specifically requested for process control purposes. The lithium results indicate HHF contamination in some samples.

B2.1.3.5 Ion Chromatography. Samples were prepared by water digest. Although a full suite of analytes were reported, only bromide was specifically requested for process control purposes. The bromide results indicate HHF contamination in some samples.

B2.1.3.6 Specific Gravity and Bulk Density. Specific gravity was determined for the drainable liquid subsamples. Results ranged from 1.31 to 1.37. There were no exceptions to the QC parameters stated (Conner 1997). Bulk density was requested only on one solids subsample from each segment in accordance with Conner (1997). Results for bulk density ranged from 1.58 to 1.7 g/mL.

B2.2 VAPOR PHASE MEASUREMENT

Vapor phase measurements were taken were taken by combustible gas meter monitoring and by in situ vapor sampling and analysis. Table B2-6 lists the DQO requirements applicable to vapor samples.

Table B2-6. Vapor Sampling Data Quality Objective Requirements for Tank 241-B-107.

Applicable DQOs	Sampling Requirements	Analytical Requirements
Safety screening Dukelow et al. (1995)	Combustible gas measurement	Flammability
Flammable gas McDuffie (1995)	Combustible gas measurement	Flammability
Hazardous vapor Osborne and Buckley (1995)	Steel canisters, triple sorbent traps, sorbent trap systems	Flammable gas, organic vapors, permanent gases
Organic solvents Meacham et al. (1997)	Steel canisters	Organic vapors

B2.2.1 Combustible Gas Meter Measurements

Before the September 1997 core sampling of tank 241-B-107, a vapor phase measurement was taken. Measurements were made previously on June 6, 1996. These measurements supported the safety screening DQO and the hazardous vapor safety screening DQO. The vapor phase screening was taken to address the flammability issue. The vapor phase measurements were taken 20 ft below the riser in the headspace of the tank, and results were obtained in the field (that is, no gas sample was sent to the laboratory for analysis). The results of the vapor phase measurements are provided in Table B2-7.

Table B2-7. Results of Headspace Measurements of Tank 241-B-107.

Measurement	Results	
	June 6, 1996	September 8, 1997
Total organic carbon	3 ppm	1.4 ppm
Lower explosive limit	2%	0%
Oxygen	20.9%	21.0%
Ammonia	25 ppm	20 ppm

B2.2.2 In Situ Vapor Sampling Results

Vapor samples were taken from the headspace of tank 241-B-107 on July 23, 1996, using the In Situ Vapor Sampling system. Headspace samples were captured using canisters and sorbent traps. Canister samples were analyzed for permanent gases using gas chromatography/thermal conductivity detection; total nonmethane organic compounds using cryogenic preconcentration followed by gas chromatography/flame ionization detection; and organic analytes using cryogenic preconcentration followed by gas chromatography/mass spectrometry (GC/MS). Samples from sorbent traps were thermally desorbed and analyzed by GC/MS.

Table B2-8 summarizes inorganic analytes, permanent gases, and total nonmethane organic compounds, along with the three analytes detected in the highest concentrations in SUMMA[1] canisters and triple sorbent traps These results were taken from Evans et al. (1997) which contains detailed descriptions of the analytical results.

B2.3 DESCRIPTION OF HISTORICAL SAMPLING EVENT

Sample data for tank 241-B-107 have been obtained for one sample received at the 222-S Laboratory on January 19, 1976, and reported on April 8, 1976 (Harden 1976). No information was available regarding sample handling for this tank. The sample was reported as yellowish brown in color, very soft, and with crystal-like chunks throughout. This description is very similar to the description for core sample 217-1 from the 1997 core (Nuzum 1997).

A small subsample was subjected to water, acid, and fusion digestions. The resulting digestates were analyzed. The solids were about 30 percent water soluble. Analytical results on each digestion were not reported, however, results were summarized to provide an overall composition. Table B2-9 shows the results. Pre-1989 analytical data have not been validated and should be used with caution.

[1]SUMMA is a trademark of Moletrics, Inc., Cleveland, Ohio.

Table B2-8. Summary Results of In Situ Vapor Sampling of the Headspace of Tank 241-B-107.[1]

Category	Sample Medium	Analyze	Vapor Concentration	Units
Inorganic analytes	Sorbent traps	NH_3	21.3 ± 3.7	ppmv
		NO_2	<0.16	ppmv
		NO	<0.16	ppmv
		H_2O	13.5 ± 0.5	mg/L
Permanent gases	SUMMA™ Canister	H_2	<17	ppmv
		CH_4	<25	ppmv
		CO_2	375	ppmv
		CO	<17	ppmv
		N_2O	<17	ppmv
Total nonmethane organic compounds	SUMMA™ Canister	Nonmethane organic compounds	<0.59	mg/m^3
Volatile organics	SUMMA™ Canister	Trichlorofluoromethane	0.288	ppmv
		Methanol	0.159	ppmv
		Acetone	0.085	ppmv
Semivolatile organics	Sorbent traps	Trichlorofluoromethane	0.260	ppmv
		2,4-Dimethylheptane[3]	0.150	ppmv
		Methanol	0.121	ppmv

Notes:

[1]Evans et al. (1997)

[2]Inorganic analyte concentrations are based on dry air at standard temperature and pressure.

[3]Tentatively identified compound

Table B2-9. Historical Analytical Data for Tank 241-B-107.[1,2]

Constituent	Reported Value	Reported Value Units
Bulk density	1.64	g/cm^3
Particle density	2.04	g/cm^3
Percent water	32.9	percent
Al_2O_3	8.9	percent
FeOOH	3.3	percent
Mg	<1.0	percent
Mn	<1.0	percent
Na_2CO_3	2.5	percent
Na_2SO_4	10.7	percent
Na_3PO_4	20	percent
$NaNO_2$	0.4	percent
$NaNO_3$	14.3	percent
Pu	2.73E-06	g/g
^{144}Ce	1.5	$\mu Ci/g$
^{137}Cs	3.2	$\mu Ci/g$
^{154}Eu	0.4	$\mu Ci/g$
^{155}Eu	1.3	$\mu Ci/g$
$Ru/^{106}Rh$	2.3	$\mu Ci/g$
^{125}Sb	5.3	$\mu Ci/g$
$^{89/90}Sr$	12.9	$\mu Ci/g$

Note:

[1]Horton (1976)

[2]The data have not been validated and should only be used with caution.

B2.4 1997 CORE SAMPLE DATA TABLES

This section contains the 1997 core sample data tables.

Table B2-10. Tank 241-B-107 Analytical Results: Aluminum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	37,800	32,700	35,300[QC:e]
S97T002088		Lower half	20,200	21,400	20,800[QC:e]
S97T002097	217:2	Upper half	21,300	20,500	20,900[QC:e]
S97T002094		Lower half	17,200	18,000	17,600
S97T002103	217:3	Upper half	17,000	16,900	17,000[QC:e]
S97T002100		Lower half	15,900	13,600	14,800[QC:e]
S97T002117	218:1	Upper half	146,000	162,000	1.54E+05[QC:d]
S97T002120	218:2	Upper half	20,300	20,400	20,400[QC:e]
S97T002123	218:4	Upper half	6,160	10,400	8,280[QC:d,e]
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	20.2	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-11. Tank 241-B-107 Analytical Results: Antimony (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<59.3	<59.3	<59.3
S97T002088		Lower half	<59.7	<59.1	<59.4
S97T002097	217:2	Upper half	<60.8	<60.6	<60.7
S97T002094		Lower half	<58.7	<58.9	<58.8
S97T002103	217:3	Upper half	<60.5	<60.8	<60.6
S97T002100		Lower half	<59	<59.3	<59.1
S97T002117	218:1	Upper half	<59.9	<59.8	<59.8
S97T002120	218:2	Upper half	<117	<118	<118
S97T002123	218:4	Upper half	<118	<118	<118

Table B2-11. Tank 241-B-107 Analytical Results: Antimony (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<24.1	<24.1	<24.1
S97T002115	218:4	Drainable liquid	<24.1	<24.1	<24.1

Table B2-12. Tank 241-B-107 Analytical Results: Arsenic (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<98.9	<98.8	<98.8
S97T002088		Lower half	<99.4	<98.6	<99
S97T002097	217:2	Upper half	<101	<101	<101
S97T002094		Lower half	<97.8	<98.2	<98
S97T002103	217:3	Upper half	<101	<101	<101
S97T002100		Lower half	<98.3	<98.8	<98.5
S97T002117	218:1	Upper half	<99.8	<99.7	<99.8
S97T002120	218:2	Upper half	<196	<196	<196
S97T002123	218:4	Upper half	<197	<197	<197
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1[QC:e]
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1[QC:e]

Table B2-13. Tank 241-B-107 Analytical Results: Barium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<49.4	<49.4	<49.4
S97T002088		Lower half	<49.7	<49.3	<49.5
S97T002097	217:2	Upper half	<50.6	<50.5	<50.5
S97T002094		Lower half	<48.9	<49.1	<49

Table B2-13. Tank 241-B-107 Analytical Results: Barium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest (Cont'd)			µg/g	µg/g	µg/g
S97T002103	217:3	Upper half	<50.4	<50.6	<50.5
S97T002100		Lower half	<49.1	<49.4	<49.3
S97T002117	218:1	Upper half	<49.9	<49.9	<49.9
S97T002120	218:2	Upper half	<97.8	<98	<97.9
S97T002123	218:4	Upper half	<98.7	<98.5	<98.6
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-14. Tank 241-B-107 Analytical Results: Beryllium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<4.94	<4.94	<4.94
S97T002088		Lower half	<4.97	<4.93	<4.95
S97T002097	217:2	Upper half	<5.06	<5.05	<5.05
S97T002094		Lower half	<4.89	<4.91	<4.9
S97T002103	217:3	Upper half	<5.04	<5.06	<5.05
S97T002100		Lower half	<4.91	<4.94	<4.93
S97T002117	218:1	Upper half	<4.99	<4.99	<4.99
S97T002120	218:2	Upper half	<9.78	<9.8	<9.79
S97T002123	218:4	Upper half	<9.87	<9.85	<9.86
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<2	<2	<2
S97T002115	218:4	Drainable liquid	<2	<2	<2

Table B2-15. Tank 241-B-107 Analytical Results: Bismuth (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	5,090	4,530	4,810[QC:c]
S97T002088		Lower half	14,200	12,900	13,600[QC:c]
S97T002097	217:2	Upper half	20,000	20,100	20,100[QC:c]
S97T002094		Lower half	15,700	16,100	15,900[QC:d]
S97T002103	217:3	Upper half	20,900	21,500	21,200[QC:d]
S97T002100		Lower half	17,400	14,900	16,200[QC:c]
S97T002117	218:1	Upper half	122	<99.7	<111[QC:e]
S97T002120	218:2	Upper half	1,130	1,100	1,120
S97T002123	218:4	Upper half	10,600	11,700	11,200[QC:d]
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-16. Tank 241-B-107 Analytical Results: Boron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	176	147	162
S97T002088		Lower half	477	401	439
S97T002097	217:2	Upper half	279	326	303
S97T002094		Lower half	97.8	144	121[QC:e]
S97T002103	217:3	Upper half	149	150	150
S97T002100		Lower half	161	106	134[QC:e]
S97T002117	218:1	Upper half	99.1	103	101
S97T002120	218:2	Upper half	357	371	364
S97T002123	218:4	Upper half	884	851	868
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-17. Tank 241-B-107 Analytical Results: Cadmium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<4.94	<4.94	<4.94
S97T002088		Lower half	<4.97	<4.93	<4.95
S97T002097	217:2	Upper half	<5.06	<5.05	<5.05
S97T002094		Lower half	<4.89	<4.91	<4.9
S97T002103	217:3	Upper half	<5.04	<5.06	<5.05
S97T002100		Lower half	<4.91	<4.94	<4.93
S97T002117	218:1	Upper half	<4.99	<4.99	<4.99
S97T002120	218:2	Upper half	<9.78	<9.8	<9.79
S97T002123	218:4	Upper half	<9.87	<9.85	<9.86
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<2	<2	<2
S97T002115	218:4	Drainable liquid	<2	<2	<2

Table B2-18. Tank 241-B-107 Analytical Results: Calcium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	1,240	1,100	1,170[QC:c]
S97T002088		Lower half	2,230	2,000	2,120[QC:c]
S97T002097	217:2	Upper half	343	405	374
S97T002094		Lower half	208	220	214
S97T002103	217:3	Upper half	297	292	295
S97T002100		Lower half	193	292	243[QC:e]
S97T002117	218:1	Upper half	267	312	290
S97T002120	218:2	Upper half	278	341	310[QC:e]
S97T002123	218:4	Upper half	366	370	368
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-19. Tank 241-B-107 Analytical Results: Cerium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<98.9	<98.8	<98.8
S97T002088		Lower half	112	136	124
S97T002097	217:2	Upper half	274	216	245[QC:e]
S97T002094		Lower half	166	195	181
S97T002103	217:3	Upper half	269	313	291
S97T002100		Lower half	213	172	193[QC:e]
S97T002117	218:1	Upper half	<99.8	<99.7	<99.8
S97T002120	218:2	Upper half	<196	<196	<196
S97T002123	218:4	Upper half	<197	<197	<197
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-20. Tank 241-B-107 Analytical Results: Chromium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	136	128	132
S97T002088		Lower half	317	280	299
S97T002097	217:2	Upper half	669	622	646
S97T002094		Lower half	473	490	482
S97T002103	217:3	Upper half	569	571	570
S97T002100		Lower half	561	487	524
S97T002117	218:1	Upper half	22.2	20.2	21.2
S97T002120	218:2	Upper half	148	158	153
S97T002123	218:4	Upper half	109	116	113

Table B2-20. Tank 241-B-107 Analytical Results: Chromium (ICP). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	97.9	100	99
S97T002115	218:4	Drainable liquid	64.3	63.9	64.1

Table B2-21. Tank 241-B-107 Analytical Results: Cobalt (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T002091	217:1	Upper half	<19.8	<19.8	<19.8
S97T002088		Lower half	<19.9	<19.7	<19.8
S97T002097	217:2	Upper half	<20.3	<20.2	<20.3
S97T002094		Lower half	<19.6	<19.6	<19.6
S97T002103	217:3	Upper half	<20.2	<20.3	<20.3
S97T002100		Lower half	<19.7	<19.8	<19.8
S97T002117	218:1	Upper half	<20	<19.9	<19.9
S97T002120	218:2	Upper half	<39.1	<39.2	<39.2
S97T002123	218:4	Upper half	<39.5	<39.4	<39.5
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<8.02	<8.02	<8.02
S97T002115	218:4	Drainable liquid	<8.02	<8.02	<8.02

Table B2-22. Tank 241-B-107 Analytical Results: Copper (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T002091	217:1	Upper half	24.1	20.3	22.2
S97T002088		Lower half	45.8	42.6	44.2
S97T002097	217:2	Upper half	36.6	32.2	34.4
S97T002094		Lower half	27.4	28.5	27.9
S97T002103	217:3	Upper half	34.9	32.9	33.9
S97T002100		Lower half	26.4	21.8	24.1
S97T002117	218:1	Upper half	<9.98	<9.97	<9.98
S97T002120	218:2	Upper half	<19.6	<19.6	<19.6
S97T002123	218:4	Upper half	26.3	25.7	26
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<4.01	<4.01	<4.01
S97T002115	218:4	Drainable liquid	<4.01	<4.01	<4.01

Table B2-23. Tank 241-B-107 Analytical Results: Iron (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T002091	217:1	Upper half	8,490	7,360	7,930[QC:c]
S97T002088		Lower half	16,600	15,100	15,900[QC:c]
S97T002097	217:2	Upper half	11,700	11,400	11,600[QC:c]
S97T002094		Lower half	10,300	10,700	10,500[QC:c]
S97T002103	217:3	Upper half	15,900	15,800	15,900
S97T002100		Lower half	12,400	10,800	11,600[QC:c]
S97T002117	218:1	Upper half	12,200	14,500	13,400[QC:c]
S97T002120	218:2	Upper half	34,800	34,300	34,600[QC:c]
S97T002123	218:4	Upper half	4,150	3,830	3,990[QC:d]
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-24. Tank 241-B-107 Analytical Results: Lanthanum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<49.4	<49.4	<49.4
S97T002088		Lower half	<49.7	<49.3	<49.5
S97T002097	217:2	Upper half	<50.6	<50.5	<50.5
S97T002094		Lower half	<48.9	<49.1	<49
S97T002103	217:3	Upper half	<50.4	<50.6	<50.5
S97T002100		Lower half	<49.1	<49.4	<49.3
S97T002117	218:1	Upper half	<49.9	<49.9	<49.9
S97T002120	218:2	Upper half	<97.8	<98	<97.9
S97T002123	218:4	Upper half	<98.7	<98.5	<98.6
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-25. Tank 241-B-107 Analytical Results: Lead (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	402	353	378
S97T002088		Lower half	977	909	943
S97T002097	217:2	Upper half	221	196	209
S97T002094		Lower half	<97.8	<98.2	<98
S97T002103	217:3	Upper half	201	195	198
S97T002100		Lower half	164	140	152
S97T002117	218:1	Upper half	782	778	780
S97T002120	218:2	Upper half	235	244	240
S97T002123	218:4	Upper half	987	1,100	1,040
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-26. Tank 241-B-107 Analytical Results: Lithium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<9.89	<9.88	<9.89
S97T002088		Lower half	<9.94	<9.86	<9.9
S97T002097	217:2	Upper half	35.5	35.2	35.4
S97T002094		Lower half	15.2	16.1	15.7
S97T002103	217:3	Upper half	25.2	25.1	25.1
S97T002100		Lower half	22.3	19.5	20.9
S97T002117	218:1	Upper half	28.8	29.2	29
S97T002120	218:2	Upper half	47.5	48.4	48
S97T002123	218:4	Upper half	70.9	73.1	72
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	84.8	87.6	86.2
S97T002115	218:4	Drainable liquid	345	337	341

Table B2-27. Tank 241-B-107 Analytical Results: Magnesium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	349	314	332
S97T002088		Lower half	667	592	630
S97T002097	217:2	Upper half	192	191	192
S97T002094		Lower half	102	104	103
S97T002103	217:3	Upper half	158	151	155
S97T002100		Lower half	121	107	114
S97T002117	218:1	Upper half	108	115	112
S97T002120	218:2	Upper half	<196	<196	<196
S97T002123	218:4	Upper half	<197	<197	<197
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-28. Tank 241-B-107 Analytical Results: Manganese (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	54.7	46.8	50.8
S97T002088		Lower half	99.1	90.1	94.6
S97T002097	217:2	Upper half	38.2	35.7	37
S97T002094		Lower half	23.6	24.3	24
S97T002103	217:3	Upper half	32.2	32.2	32.2
S97T002100		Lower half	25.1	21.7	23.4
S97T002117	218:1	Upper half	64.7	77.3	71
S97T002120	218:2	Upper half	309	305	307
S97T002123	218:4	Upper half	38.2	36.2	37.2
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<4.01	<4.01	<4.01
S97T002115	218:4	Drainable liquid	<4.01	<4.01	<4.01

Table B2-29. Tank 241-B-107 Analytical Results: Molybdenum (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<49.4	<49.4	<49.4
S97T002088		Lower half	<49.7	<49.3	<49.5
S97T002097	217:2	Upper half	<50.6	<50.5	<50.5
S97T002094		Lower half	<48.9	<49.1	<49
S97T002103	217:3	Upper half	<50.4	<50.6	<50.5
S97T002100		Lower half	<49.1	<49.4	<49.3
S97T002117	218:1	Upper half	<49.9	<49.9	<49.9
S97T002120	218:2	Upper half	<97.8	<98	<97.9
S97T002123	218:4	Upper half	<98.7	<98.5	<98.6
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-30. Tank 241-B-107 Analytical Results: Neodymium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<98.9	<98.8	<98.8
S97T002088		Lower half	<99.4	<98.6	<99
S97T002097	217:2	Upper half	<101	<101	<101
S97T002094		Lower half	<97.8	<98.2	<98
S97T002103	217:3	Upper half	<101	<101	<101
S97T002100		Lower half	<98.3	<98.8	<98.5
S97T002117	218:1	Upper half	<99.8	<99.7	<99.8
S97T002120	218:2	Upper half	<196	<196	<196
S97T002123	218:4	Upper half	<197	<197	<197
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-31. Tank 241-B-107 Analytical Results: Nickel (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	47.2	44.8	46
S97T002088		Lower half	91.2	81.7	86.5
S97T002097	217:2	Upper half	32.1	22.7	27.4[QC:e]
S97T002094		Lower half	<19.6	<19.6	<19.6
S97T002103	217:3	Upper half	32	28.6	30.3
S97T002100		Lower half	29.3	29.6	29.5
S97T002117	218:1	Upper half	<20	<19.9	<19.9
S97T002120	218:2	Upper half	<39.1	<39.2	<39.2
S97T002123	218:4	Upper half	<39.5	<39.4	<39.5
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<8.02	<8.02	<8.02
S97T002115	218:4	Drainable liquid	<8.02	<8.02	<8.02

Table B2-32. Tank 241-B-107 Analytical Results: Phosphorus (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	14,500	12,900	13,700[QC:c]
S97T002088		Lower half	24,700	21,900	23,300[QC:d]
S97T002097	217:2	Upper half	30,900	29,600	30,300[QC:c]
S97T002094		Lower half	30,900	32,500	31,700
S97T002103	217:3	Upper half	26,600	26,900	26,800[QC:c]
S97T002100		Lower half	29,800	26,000	27,900[QC:c]
S97T002117	218:1	Upper half	2,330	2,030	2,180[QC:c]
S97T002120	218:2	Upper half	4,570	4,360	4,470[QC:d]
S97T002123	218:4	Upper half	57,800	50,900	54,400[QC:c]
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	2,710	2,790	2,750
S97T002115	218:4	Drainable liquid	6,460	6,360	6,410[QC:c]

Table B2-33. Tank 241-B-107 Analytical Results: Potassium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<494	<494	<494
S97T002088		Lower half	<497	<493	<495
S97T002097	217:2	Upper half	<506	<505	<506
S97T002094		Lower half	<489	<491	<490
S97T002103	217:3	Upper half	<504	<506	<505
S97T002100		Lower half	<491	<494	<493
S97T002117	218:1	Upper half	<499	<499	<499
S97T002120	218:2	Upper half	<978	<980	<979[QC:d]
S97T002123	218:4	Upper half	<987	<985	<986
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	208	215	212
S97T002115	218:4	Drainable liquid	<200	<200	<200[QC:d]

Table B2-34. Tank 241-B-107 Analytical Results: Samarium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T002091	217:1	Upper half	<98.9	<98.8	<98.8
S97T002088		Lower half	<99.4	<98.6	<99
S97T002097	217:2	Upper half	<101	<101	<101
S97T002094		Lower half	<97.8	<98.2	<98
S97T002103	217:3	Upper half	<101	<101	<101
S97T002100		Lower half	<98.3	<98.8	<98.5
S97T002117	218:1	Upper half	<99.8	<99.7	<99.8
S97T002120	218:2	Upper half	<196	<196	<196
S97T002123	218:4	Upper half	<197	<197	<197
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-35. Tank 241-B-107 Analytical Results: Selenium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T002091	217:1	Upper half	<98.9	<98.8	<98.8
S97T002088		Lower half	<99.4	119	<109
S97T002097	217:2	Upper half	108	<101	<105
S97T002094		Lower half	135	139	137
S97T002103	217:3	Upper half	<101	<101	<101[QC:d]
S97T002100		Lower half	130	112	121
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<40.1	<40.1	<40.1
S97T002115	218:4	Drainable liquid	<40.1	<40.1	<40.1

Table B2-36. Tank 241-B-107 Analytical Results: Silicon (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	1,700	1,590	1,650[QC:b,c]
S97T002088		Lower half	4,390	3,760	4,080[QC:b,c]
S97T002097	217:2	Upper half	8,160	8,400	8,280[QC:b,c]
S97T002094		Lower half	5,600	6,160	5,880[QC:b,c]
S97T002103	217:3	Upper half	9,250	10,400	9,830[QC:b,d]
S97T002100		Lower half	7,000	5,900	6,450[QC:b,c]
S97T002117	218:1	Upper half	990	976	983[QC:b,c]
S97T002120	218:2	Upper half	3,360	3,460	3,410[QC:b,c]
S97T002123	218:4	Upper half	8,700	8,390	8,550[QC:b,d]
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-37. Tank 241-B-107 Analytical Results: Silver (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<9.89	<9.88	<9.89
S97T002088		Lower half	<9.94	<9.86	<9.9
S97T002097	217:2	Upper half	<10.1	<10.1	<10.1
S97T002094		Lower half	<9.78	<9.82	<9.8
S97T002103	217:3	Upper half	<10.1	<10.1	<10.1
S97T002100		Lower half	<9.83	<9.88	<9.86
S97T002117	218:1	Upper half	<9.98	<9.97	<9.98
S97T002120	218:2	Upper half	<19.6	<19.6	<19.6
S97T002123	218:4	Upper half	<19.7	<19.7	<19.7
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	11.3	11.9	11.6
S97T002115	218:4	Drainable liquid	10.4	10.3	10.4

Table B2-38. Tank 241-B-107 Analytical Results: Sodium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	1.50E+05	1.48E+05	1.49E+05[QC:c]
S97T002088		Lower half	1.63E+05	1.57E+05	1.60E+05
S97T002097	217:2	Upper half	1.48E+05	1.52E+05	1.50E+05[QC:c]
S97T002094		Lower half	1.33E+05	1.37E+05	1.35E+05[QC:d]
S97T002103	217:3	Upper half	1.29E+05	1.29E+05	1.29E+05
S97T002100		Lower half	1.34E+05	1.32E+05	1.33E+05[QC:c]
S97T002117	218:1	Upper half	17,100	16,600	16,900[QC:c]
S97T002120	218:2	Upper half	1.68E+05	1.65E+05	1.67E+05[QC:c]
S97T002123	218:4	Upper half	2.25E+05	2.29E+05	2.27E+05[QC:d]
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	1.54E+05	1.58E+05	1.56E+05[QC:d]
S97T002115	218:4	Drainable liquid	1.39E+05	1.35E+05	1.37E+05[QC:c]

Table B2-39. Tank 241-B-107 Analytical Results: Strontium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	109	97.7	103
S97T002088		Lower half	204	184	194
S97T002097	217:2	Upper half	177	171	174
S97T002094		Lower half	172	185	179
S97T002103	217:3	Upper half	197	196	197
S97T002100		Lower half	259	226	243
S97T002117	218:1	Upper half	<9.98	<9.97	<9.98
S97T002120	218:2	Upper half	33.5	33	33.3
S97T002123	218:4	Upper half	90.7	94.2	92.5
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<4.01	<4.01	<4.01
S97T002115	218:4	Drainable liquid	<4.01	<4.01	<4.01

Table B2-40. Tank 241-B-107 Analytical Results: Sulfur (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			$\mu g/g$	$\mu g/g$	$\mu g/g$
S97T002091	217:1	Upper half	27,300	24,800	26,100[QC:c]
S97T002088		Lower half	22,200	20,700	21,500[QC:c]
S97T002097	217:2	Upper half	7,600	8,150	7,880[QC:c]
S97T002094		Lower half	4,960	5,020	4,990
S97T002103	217:3	Upper half	4,520	4,640	4,580
S97T002100		Lower half	4,560	4,600	4,580
S97T002117	218:1	Upper half	1,020	1,010	1,020
S97T002120	218:2	Upper half	56,800	55,300	56,100[QC:c]
S97T002123	218:4	Upper half	47,900	55,400	51,700[QC:d]
Liquids			$\mu g/mL$	$\mu g/mL$	$\mu g/mL$
S97T002078	217:2	Drainable liquid	10,300	10,600	10,500
S97T002115	218:4	Drainable liquid	8,190	8,100	8,150[QC:c]

Table B2-41. Tank 241-B-107 Analytical Results: Thallium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			$\mu g/g$	$\mu g/g$	$\mu g/g$
S97T002091	217:1	Upper half	<198	<198	<198
S97T002088		Lower half	<199	<197	<198
S97T002097	217:2	Upper half	<203	<202	<203
S97T002094		Lower half	<196	<196	<196
S97T002103	217:3	Upper half	<202	<203	<203
S97T002100		Lower half	<197	<198	<198
S97T002117	218:1	Upper half	<200	<199	<200
S97T002120	218:2	Upper half	<391	<392	<392
S97T002123	218:4	Upper half	<395	<394	<395
Liquids			$\mu g/mL$	$\mu g/mL$	$\mu g/mL$
S97T002078	217:2	Drainable liquid	<80.2	<80.2	<80.2
S97T002115	218:4	Drainable liquid	<80.2	<80.2	<80.2

Table B2-42. Tank 241-B-107 Analytical Results: Titanium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	25.7	23	24.4
S97T002088		Lower half	47.8	41.8	44.8
S97T002097	217:2	Upper half	<10.1	<10.1	<10.1
S97T002094		Lower half	<9.78	<9.82	<9.8
S97T002103	217:3	Upper half	<10.1	<10.1	<10.1
S97T002100		Lower half	<9.83	<9.88	<9.86
S97T002117	218:1	Upper half	<9.98	14.9	<12.4[QC:e]
S97T002120	218:2	Upper half	<19.6	<19.6	<19.6
S97T002123	218:4	Upper half	<19.7	<19.7	<19.7
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<4.01	<4.01	<4.01
S97T002115	218:4	Drainable liquid	<4.01	<4.01	<4.01

Table B2-43. Tank 241-B-107 Analytical Results: Total Uranium (ICP)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	2,400	2,300	2,350[QC:e]
S97T002088		Lower half	3,620	3,230	3,430
S97T002097	217:2	Upper half	1,090	1,390	1,240[QC:e]
S97T002094		Lower half	584	<491	<538[QC:d]
S97T002103	217:3	Upper half	1,160	1,220	1,190[QC:d]
S97T002100		Lower half	1,720	1,720	1,720
S97T002117	218:1	Upper half	<499	<499	<499
S97T002120	218:2	Upper half	3,430	3,140	3,290
S97T002123	218:4	Upper half	2,640	2,280	2,460
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<200	<200	<200
S97T002115	218:4	Drainable liquid	<200	<200	<200

Table B2-44. Tank 241-B-107 Analytical Results: Vanadium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	<49.4	<49.4	<49.4
S97T002088		Lower half	<49.7	<49.3	<49.5
S97T002097	217:2	Upper half	<50.6	<50.5	<50.5
S97T002094		Lower half	<48.9	<49.1	<49
S97T002103	217:3	Upper half	<50.4	<50.6	<50.5
S97T002100		Lower half	<49.1	<49.4	<49.3
S97T002117	218:1	Upper half	<49.9	<49.9	<49.9
S97T002120	218:2	Upper half	<97.8	<98	<97.9
S97T002123	218:4	Upper half	<98.7	<98.5	<98.6
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<20.1	<20.1	<20.1
S97T002115	218:4	Drainable liquid	<20.1	<20.1	<20.1

Table B2-45. Tank 241-B-107 Analytical Results: Zinc (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			µg/g	µg/g	µg/g
S97T002091	217:1	Upper half	203	193	198
S97T002088		Lower half	384	355	370
S97T002097	217:2	Upper half	236	236	236
S97T002094		Lower half	122	123	123
S97T002103	217:3	Upper half	193	162	178
S97T002100		Lower half	266	244	255
S97T002117	218:1	Upper half	266	222	244
S97T002120	218:2	Upper half	228	225	227
S97T002123	218:4	Upper half	334	317	326
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	<4.01	<4.01	<4.01
S97T002115	218:4	Drainable liquid	<4.01	<4.01	<4.01

Table B2-46. Tank 241-B-107 Analytical Results: Zirconium (ICP).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids: acid digest			μg/g	μg/g	μg/g
S97T002091	217:1	Upper half	67.1	59.9	63.5
S97T002088		Lower half	170	152	161
S97T002097	217:2	Upper half	314	300	307
S97T002094		Lower half	153	158	156
S97T002103	217:3	Upper half	264	267	266
S97T002100		Lower half	219	183	201
S97T002117	218:1	Upper half	<9.98	<9.97	<9.98[QC:c]
S97T002120	218:2	Upper half	47.3	39.9	43.6
S97T002123	218:4	Upper half	115	109	112
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<4.01	<4.01	<4.01
S97T002115	218:4	Drainable liquid	<4.01	<4.01	<4.01

Table B2-47. Tank 241-B-107 Analytical Results: Bromide (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			μg/g	μg/g	μg/g
S97T002092	217:1	Upper half	<1,030	<1,030	<1,030
S97T002089		Lower half	<1,070	<1,050	<1,060
S97T002098	217:2	Upper half	<970	<961	<966
S97T002095		Lower half	<995	<1,000	<998
S97T002104	217:3	Upper half	1,690	1,720	1,700
S97T002101		Lower half	1,800	1,750	1,780
S97T002118	218:1	Upper half	442	462	452
S97T002121	218:2	Upper half	1,260	1,260	1,260
S97T002124	218:4	Upper half	1,210	1,230	1,220
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	3,840	3,900	3,870
S97T002115	218:4	Drainable liquid	6,180	6,260	6,220

Table B2-48. Tank 241-B-107 Analytical Results: Chloride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			μg/g	μg/g	μg/g
S97T002092	217:1	Upper half	1,250	1,220	1,230
S97T002089		Lower half	1,200	1,220	1,210
S97T002098	217:2	Upper half	1,360	1,270	1,310
S97T002095		Lower half	1,440	1,460	1,450
S97T002104	217:3	Upper half	1,270	1,290	1,280
S97T002101		Lower half	1,320	1,320	1,320
S97T002118	218:1	Upper half	234	233	234
S97T002121	218:2	Upper half	1,200	1,140	1,170
S97T002124	218:4	Upper half	239	247	243
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	2,270	2,180	2,230
S97T002115	218:4	Drainable liquid	2,420	2,450	2,440

Table B2-49. Tank 241-B-107 Analytical Results: Fluoride (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			μg/g	μg/g	μg/g
S97T002092	217:1	Upper half	24,300	24,700	24,500
S97T002089		Lower half	19,300	19,200	19,300
S97T002098	217:2	Upper half	22,300	21,700	22,000
S97T002095		Lower half	6,080	7,380	6,730
S97T002104	217:3	Upper half	6,310	6,790	6,550
S97T002101		Lower half	5,460	5,320	5,390
S97T002118	218:1	Upper half	813	785	799
S97T002121	218:2	Upper half	33,200	32,500	32,800
S97T002124	218:4	Upper half	45,000	45,300	45,200
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	708	739	723
S97T002115	218:4	Drainable liquid	784	757	770

Table B2-50. Tank 241-B-107 Analytical Results: Nitrate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
S97T002092	217:1	Upper half	2.08E+05	2.06E+05	2.07E+05
S97T002089		Lower half	1.76E+05	1.83E+05	1.80E+05
S97T002098	217:2	Upper half	2.00E+05	1.99E+05	1.99E+05
S97T002095		Lower half	2.28E+05	2.23E+05	2.25E+05
S97T002104	217:3	Upper half	2.17E+05	2.14E+05	2.16E+05
S97T002101		Lower half	2.18E+05	2.20E+05	2.19E+05
S97T002118	218:1	Upper half	24500	24,600	24,600
S97T002121	218:2	Upper half	1.56E+05	1.56E+05	1.56E+05
S97T002124	218:4	Upper half	38,000	38,400	38,200
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	3.44E+05	3.48E+05	3.46E+05
S97T002115	218:4	Drainable liquid	3.12E+05	3.17E+05	3.15E+05

Table B2-51. Tank 241-B-107 Analytical Results: Nitrite (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
S97T002092	217:1	Upper half	4,520	4,530	4,530
S97T002089		Lower half	4,490	4,630	4,560
S97T002098	217:2	Upper half	4,120	4,160	4,140
S97T002095		Lower half	4,580	4,450	4,510
S97T002104	217:3	Upper half	4,670	4,550	4,610
S97T002101		Lower half	4,730	4,830	4,780
S97T002118	218:1	Upper half	764	780	772
S97T002121	218:2	Upper half	3,560	3,430	3,490
S97T002124	218:4	Upper half	1,190	1,210	1,200
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	7,950	7,610	7,780
S97T002115	218:4	Drainable liquid	5,270	5,200	5,240

Table B2-52. Tank 241-B-107 Analytical Results: Phosphate (IC)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
S97T002092	217:1	Upper half	16,300	16,800	16,600
S97T002089		Lower half	7,570	7,250	7,410
S97T002098	217:2	Upper half	7,760	7,390	7,580
S97T002095		Lower half	14,600	16,000	15,300
S97T002104	217:3	Upper half	14,900	17,000	15,900
S97T002101		Lower half	18,900	18,200	18,500
S97T002118	218:1	Upper half	8,100	8,320	8,210
S97T002121	218:2	Upper half	11,200	11,000	11,100
S97T002124	218:4	Upper half	1.48E+05	1.48E+05	1.48E+05
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	7,730	9,120	8,430
S97T002115	218:4	Drainable liquid	19,500	19,500	19,500

Table B2-53. Tank 241-B-107 Analytical Results: Sulfate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			µg/g	µg/g	µg/g
S97T002092	217:1	Upper half	87,100	88,100	87,600
S97T002089		Lower half	66,600	61,000	63,800
S97T002098	217:2	Upper half	22,300	22,800	22,500
S97T002095		Lower half	16,200	15,100	15,600
S97T002104	217:3	Upper half	13,200	12,800	13,000
S97T002101		Lower half	13,200	13,200	13,200
S97T002118	218:1	Upper half	2,580	2,630	2,600
S97T002121	218:2	Upper half	1.62E+05	1.61E+05	1.62E+05
S97T002124	218:4	Upper half	1.36E+05	1.37E+05	1.37E+05
Liquids			µg/mL	µg/mL	µg/mL
S97T002078	217:2	Drainable liquid	27,200	26,500	26,800
S97T002115	218:4	Drainable liquid	21,400	21,300	21,400

Table B2-54. Tank 241-B-107 Analytical Results: Oxalate (IC).

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			μg/mL	μg/mL	μg/mL
S97T002078	217:2	Drainable liquid	<1,070	<1,070	<1,070
S97T002115	218:4	Drainable liquid	<1,070	<1,070	<1,070

Table B2-55. Tank 241-B-107 Analytical Results: Bulk Density.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			g/mL	g/mL	g/mL
S97T002062	217:1	Upper half	1.62	n/a	1.62
S97T002061		Lower half	1.68	n/a	1.68
S97T002064	217:2	Upper half	1.7	n/a	1.7
S97T002063		Lower half	1.58	n/a	1.58
S97T002067	217:3	Upper half	1.61	n/a	1.61
S97T002066		Lower half	1.58	n/a	1.58
S97T002106	218:2	Upper half	1.7	n/a	1.7

Note:

n/a = not applicable

Table B2-56. Tank 241-B-107 Analytical Results: Percent Water (TGA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Solids			%	%	%
S97T002071	217:1	Upper half	51.5	52.5	52
S97T002069		Lower half	44.4	41.9	43.2
S97T002075	217:2	Upper half	39.3	41.1	40.2
S97T002073		Lower half	40.5	38.3	39.4
S97T002082	217:3	Upper half	40.7	40.7	40.7
S97T002080		Lower half	33.5	41.2	37.4
S97T002109	218:1	Upper half	5.24	6.32	5.78
S97T002110	218:2	Upper half	34.1	35.9	35
S97T002112	218:4	Upper half	33.1	29.4	31.3

Table B2-56. Tank 241-B-107 Analytical Results: Percent Water (TGA). (2 sheets)

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			%	%	%
S97T002077	217:2	Drainable liquid	58.8	57.4	58.1
S97T002084	217:3	Drainable liquid	55.1	55.1	55.1
S97T002114	218:4	Drainable liquid	59.1	59.6	59.3

Table B2-57. Tank 241-B-107 Analytical Results: Specific Gravity.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			Unitless	Unitless	Unitless
S97T002077	217:2	Drainable liquid	1.33	1.32	1.33
S97T002084	217:3	Drainable liquid	1.37	1.36	1.37
S97T002114	218:4	Drainable liquid	1.31	1.31	1.31

Table B2-58. Tank 241-B-107 Analytical Results: Total Alpha.

Sample Number	Sample Location	Sample Portion	Result	Duplicate	Mean
Liquids			µCi/mL	µCi/mL	µCi/mL
S97T002077	217:2	Drainable liquid	<2.67E-04	2.26E-04	<2.46E-04
S97T002084	217:3	Drainable liquid	<1.29E-04	<2.12E-04	<1.71E-04
S97T002114	218:4	Drainable liquid	<2.67E-04	<1.29E-04	<1.98E-04
Solids: fusion			µCi/g	µCi/g	µCi/g
S97T002090	217:1	Upper half	0.0706	0.0559	0.0633 QC:c,e
S97T002087		Lower half	0.0917	0.0789	0.0853 QC:c
S97T002096	217:2	Upper half	0.0825	0.0809	0.0817 QC:c
S97T002093		Lower half	0.078	0.0723	0.0752 QC:c
S97T002102	217:3	Upper half	0.08	0.073	0.0765 QC:c
S97T002099		Lower half	0.0444	0.0445	0.0445 QC:c
S97T002119	218:2	Upper half	0.0285	0.0299	0.0292 QC:c
S97T002122	218:4	Upper half	0.0596	0.0418	0.0507 QC:c

B3.0 ASSESSMENT OF CHARACTERIZATION RESULTS

This section discusses the overall quality and consistency of the current sampling results for tank 241-B-107 and provides the results of an analytical-based inventory calculation.

This section also evaluates sampling and analysis factors that may impact data interpretation. These factors are used to assess overall data quality and consistency and to identify limitations in data use.

B3.1 FIELD OBSERVATIONS

Sample recovery for core 217 was good (see Table B2-2). Sample recovery for core 218 was poor, and the samples had a large amount of liner liquid. The presence of a large amount of liner liquid deserves further attention. Individual core sample segments are retrieved from the drill string and placed in a liner, which is placed in a cask for shipment to the laboratory. It is possible that a small amount of HHF or condensation may contribute to the liner liquid, but any appreciable amount (>5 mL) of liquid in the liner must have come from inside the sampler. The sampler is designed with a ball valve at the bottom which snaps shut when the piston is fully retracted. Extrusion reports indicated that the valve was shut on all samplers. The only feasible paths for the liquid to drain from the sampler is through the valve or around the piston, which is fitted with an o-ring washer.

The large amount of liquid in the core 218 samples is also curious. The solid subsample recovered from the top segment was very dry (5.78 percent water). It is unlikely that the waste below the surface is as wet as the samples would indicate (100-300 mL of liquid per segment, counting drainable and liner liquid). It is possible that the hard, dry waste at the surface partially plugged the bit, or that an obstruction such as a metal tape hindered full recovery. It is not feasible that the bit was entirely plugged as no samples would have been recovered in this case. If this happened, then any free liquid (surface or interstitial) could have been preferentially sucked into the sampler. Neither free nor interstitial liquid is likely to be the source of the liquid observed, because the top sample was very dry (discounting the possibility of surface liquid) and the solids recovered in segment 2 were sludge-like (interstitial liquid cannot flow freely in sludge). The other possible source of the liquid is HHF.

Analyses of the samples for lithium and bromide indicate that HHF intrusion did occur. Results for bromide for the solids were as high as 1,780 μg/g and as high as 6,220 μg/mL for liquids. The target concentration of bromide in HHF is around 20,000 μg/mL. These results indicate that HHF intrusion was significant. Table B3-1 shows the estimated amount of intrusion by HHF, calculated following Winkelman (1996). Contamination from bromide is considered to be a more accurate measure of intrusion because lithium in HHF may precipitate when contacting tank waste. Contamination by bromide contributed as much as 35 percent of the measured water concentration. The largest change in percent water is 4.8 percent for solids (the upper half of segment 217:3) and 10.5 percent for liquids (the drainable liquid from segment 218:3).

Table B3-2 shows the analyses on the liner liquids recovered The results indicate that the liner liquid is almost exclusively HHF, confirming that intrusion was very significant. The data from core 218 should not be used without considering these issues.

Table B3-1. Estimated Hydrostatic Head Fluid Intrusion for Tank 241-B-107 Core Samples.

Location	Sample Number	Percent H_2O by TGA	Corrected Percent H_2O in Tank		Percent H_2O from HHF	
			Li	Br	Li[1]	Br[1]
Solids						
C217:1 UH	S97T002071	52.0%	52.0%	52.0%	-	-
C217:1 LH	S97T002069	43.2%	43.2%	43.2%	-	-
C217:2 UH	S97T002075	40.2%	39.2%	40.2%	4.2%	-
C217:2 LH	S97T002073	39.4%	39.0%	39.4%	1.9%	-
C217:3 UH	S97T002082	40.7%	40.0%	35.9%	3.0%	18.5%
C217:3 LH	S97T002080	37.4%	36.7%	32.1%	2.7%	21.0%
C218:1 UH	S97T002109	5.8%	4.5%	3.9%	24.0%	34.6%
C218:2 UH	S97T002110	35.0%	33.5%	31.2%	6.5%	15.9%
C218:3 UH	S97T002112	31.3%	28.8%	27.4%	11.0%	17.3%
Liquids						
C217:2 DL	S97T002077	58.1%	56.8%	52.1%	5.3%	22.2%
C218:4 DL	S97T002114	59.4%	53.8%	48.9%	20.9%	35.3%

Note:

[1]If the lithium or bromide analytical result was less than detectable, no percent change is calculated.

Table B3-2. Liner Liquid and Hydrostatic Head Fluid Data for Tank 241-B-107 Core Samples.

Sample	Core-Segment	Specific Gravity	%H_2O	Li $\mu g/mL$	Br $\mu g/mL$	%HHF Lithium	%HHF Bromide
S97T002033	HHF	n/r	n/r	2,080	22,400	n/a	n/a
S97T002293	217-2	n/r	n/r	1,850	n/r	88.9	n/a
S97T002297	217-3	1.026	93.48	1,800	22,500	86.5	100.4
S97T002298	218-3	1.003	96.44	2,210	26,700	106.3	119.2
S97T002299	218-4	1.008	96.14	2,160	26,600	103.8	118.8

Note:
n/r = not reported

B3.2 QUALITY CONTROL ASSESSMENT

The usual QC assessment includes an evaluation of the appropriate standard recoveries, spike recoveries, duplicate analyses, and blanks that are performed in conjunction with the chemical analyses. All pertinent QC tests were conducted on 1997 core samples, allowing a full assessment regarding the accuracy and precision of the data. The SAP (Conner 1997) established specific criteria for all analytes. Sample and duplicate pairs, with one or more QC results outside the specified criteria, were identified by footnotes in the data summary tables.

The standard and spike recovery results provide an estimate of analysis accuracy. If a standard or spike recovery is above or below the given criterion, the analytical results may be biased high or low, respectively. The precision is estimated by the RPD, which is defined as the absolute value of the difference between the primary and duplicate samples, divided by their mean, times 100.

All QC results for the DSC, TGA, density, specific gravity, IC, and ICP analyses requested in the SAP were within the boundaries specified. The RPD between primary and duplicate results for total alpha on the core 217, segment 1, upper half fused subsample (S97T002090) was 23.2%, and the RPD for total alpha on the core 218, segment 4, upper half fused subsample (S97T002122) was 35.1%. These elevated RPDs for total alpha were caused by low alpha activity in the samples, and reruns were not requested. Spike recoveries for total alpha were below the 75-125% limit given in the SAP for 7 subsamples. Two of these spike recoveries were within the control limits for the laboratory control standard, and reruns were not requested. Rerun analyses on the other 5 subsamples did not improve spike recovery, and the low recoveries were attributed to sample matrix interference. Additional reruns were not requested. All other QC results for the analyses requested in the SAP were within the boundaries specified (Nuzum 1997).

It should be noted the SAP requested bromide as the only IC analyte and lithium as the only ICP analyte. Results for other IC and ICP analytes were provided by the laboratory as "opportunistic" data; that is, they were reported because results for these analytes were generated along with the bromide and lithium data. No QC parameters were applied to the opportunistic data. Opportunistic ICP and IC data are used in this document for best basis inventory calculations and mass and charge balances. Had the same requirements that were applied to lithium been applied to the rest of the ICP analytes, then aluminum, bismuth, iron, silicon, and sodium would have failed QC for over half of the samples. These projected failures are typically for spike recoveries that were above or below the range specified for lithium. The QC results for IC analytes other than bromide were all within the limits applied to bromide.

B3.3 DATA CONSISTENCY CHECKS

Comparing different analytical methods is helpful in assessing the consistency and quality of the data. Several comparisons were possible with the data set provided by the two core samples: a comparison of phosphorus as analyzed by ICP to phosphate as analyzed by IC and a comparison of sulfur as analyzed by ICP to sulfate as analyzed by IC. In addition, mass and charge balances were calculated to help assess the overall data consistency.

B3.3.1 Comparison of Results from Different Analytical Methods

The following data consistency checks compare the results from two analytical methods. Agreement between the two methods strengthens the credibility of both results, but poor agreement brings the reliability of the data into question.

The phosphorus and sulfur results by ICP are compared with the corresponding phosphate and sulfate results by IC in Table B3-3. The phosphorus/phosphate results on the drainable liquids and on core 218 solids, along with all of the sulfur/sulfate results, are in good agreement (highest RPD is 21.0 percent). This indicates that the methods are in good agreement for these analytes. The lack of agreement seen in the comparison of phosphorus and phosphate for core 217 solids indicates that a portion of the phosphorus is not water soluble. (IC analyses for solids were performed after a water digestion, and ICP analyses were performed after an acid digestion.)

If the insoluble phosphorus is assumed to exist as $BiPO_4$, then the concentration of bismuth can be predicted. Table B3-4 shows the results of this comparison which indicate that the analytical bismuth result by ICP is about half the concentration predicted. This is not surprising because an excess of phosphate was used in processing. It may be that other forms of insoluble phosphorus are present in the waste, for example, $Ca_3(PO_4)_2$ or $Zn_3(PO_4)_2$, or perhaps the acid digestion was not rigorous enough to dissolve all of the $BiPO_4$.

Table B3-3. Comparison of ICP and IC Analytes for Tank 241-B-107 Core Samples.

Sample Location	Sample Portion	P (as PO_4) by ICP	PO_4 by IC	RPD	S (as SO_4) by ICP	SO_4 by IC	RPD
Solids		µg/g	µg/g		µg/g	µg/g	µg/g
217:1	Upper half	42,000	16,600	86.7	78,300	87,600	11.2
	Lower half	71,400	7,410	162.4	64,500	63,800	1.1
217:2	Upper half	92,900	7,580	169.8	23,640	22,500	4.9
	Lower half	97,100	15,300	145.6	14,970	15,600	4.1
217:3	Upper half	82,100	15,900	135.1	13,740	13,000	5.5
	Lower half	85,500	18,500	128.8	13,740	13,200	4.0
218:1	Upper half	6,690	8,210	20.5	3,060	2,600	16.2
218:2	Upper half	13,700	11,100	21	168,000	162,000	3.8
218:4	Upper half	1.67E+05	1.48E+05	11.9	1.55E+05	1.37E+05	12.4
Liquids		µg/mL	µg/mL		µg/mL	µg/mL	
217:2	Drainable liquid	8,430	8,430	0	31,500	26,800	16.1
218:4	Drainable liquid	19,600	19,500	0.7	24,450	21,400	13.3

Table B3-4. Comparison of Insoluble Phosphorus to Bismuth in Tank 241-B-107.

Sample Location	Sample Portion	P (as PO_4) by ICP (µg/g)	PO_4 by IC (µg/g)	Insoluble PO_4 (ICP-IC) (µg/g)	Predicted Bi[1] (µg/g)	Measured Bi (ICP) (µg/g)	Bi Ratio[2]
217-1	UH	42,000	16,600	25,400	11,700	4,810	2.43
	LH	71,400	7,410	63,990	29,400	13,600	2.16
217-2	UH	92,900	7,580	85,320	39,200	20,100	1.95
	LH	97,100	15,300	81,800	37,600	15,900	2.36
217-3	UH	82,100	15,900	66,200	30,400	21,200	1.43
	LH	85,500	18,500	67,000	30,800	16,200	1.90

Notes:

[1]Stoichiometric amount of bismuth needed to account for insoluble PO_4, assumed to exist as BiPO4

[2]Ratio of predicted bismuth to measured bismuth by ICP

B3.3.2 Mass and Charge Balances

The principal objective in performing mass and charge balances is to determine whether the measurements are consistent. In calculating the balances, only the analytes listed in Section B2.4, which were detected at a concentration of 1,000 μg/g or greater (on average), were considered. For aluminum, iron, silicon, and uranium in solids, an oxide and/or hydroxide composition was assumed, and the ICP results from the tables in Section B2.4 were adjusted accordingly. Mass balance results were generated by converting all analytical results to a weight percent basis.

Table B3-5 shows the mass balance for each subsample. Mass balance results for all but two subsamples ranged from 87 to 99 percent. The result for core 217, segment 1, upper half solids is 114 percent. All these results are reasonable and suggest that the analyses and assumptions are reasonably accurate. The mass balance result for core 218, segment 1, upper half solids is 58 percent. This sample is characterized by a low percent water and high aluminum, with few anions detected by IC. It is suggested that the sample contains substantially more aluminum and perhaps other metal oxide/hydroxides, and that the acid digestion used before ICP analysis was not rigorous enough to dissolve all of the solids. This type of sample (low moisture, high aluminum, poor dissolution by acid digestion) has been seen before in Hanford wastes, for example, the top layer of tank 241-U-110 (Stevens 1997).

Table B3-6 shows the charge balance. Species assumed to exist in oxide or hydroxide form were not used to calculate the charge balance, nor were analytes that were below detection limits or less than 0.1 weight percent. Results for the remaining analytes were converted from mass (μg/g or μg/mL) to equivalents (μeq/g or μeq/mL) based on the molecular weight and valence state of the ion. The charge balance is computed as the ratio of cations to anions. About half the results are in good agreement, falling within the range of 0.91 to 1.04. However, the results for core 217 solids (except the top sample) range from 1.29 to 1.59. This suggests a problem with the analyses or the assumptions used to generate the mass balance. A likely explanation is that a significant amount of hydroxide exists as NaOH associated with the water in the samples, and that much of the aluminum is present as aluminate, $Al(OH)_4^-$, rather than $Al(OH)_3$.

Table B3-5. Tank 241-B-107 Mass Balance.

Core: Seg	Portion	H_2O	Na	Al	Bi	Fe	Si	U	Cl	F	NO_3	NO_2	PO_4	SO_4	Sum
Liquids		%	μg/mL												%[1]
217:2	DL	58.1	156,000	<20.1	<40.1	<20.1	<20.1	<200	2,230	723	346,000	7,780	8,430	26,800	99
218:4	DL	59.3	137,000	<20.1	<40.1	<20.1	<20.1	<200	2,440	770	315,000	5,240	19,500	21,400	98
Core: Seg	Portion	H_2O	Na	$Al(OH)_3$	Bi	FeO(OH)	SiO_3	$UO_2(OH)_2$	Cl	F	NO_3	NO_2	PO_4[2]	SO_4	Sum
Solids		%	μg/g												%
217:1	UH	52	149,000	102,000	4,810	12,600	4,470	3,000	1,230	24,500	207,000	4,530	16,600	87,600	114
	LH	43.2	160,000	60,000	13,600	25,300	11,000	4,380	1,210	19,300	180,000	4,560	7,410	63,800	98
217:2	UH	40.2	150,000	60,400	20,100	18,500	22,400	1,580	1,310	22,000	199,000	4,140	7,580	22,500	93
	LH	39.4	135,000	50,800	15,900	16,700	15,900	<538	1,450	6,730	225,000	4,510	15,300	15,600	90
217:3	UH	40.7	129,000	49,100	21,200	25,300	26,600	1,520	1,280	6,550	216,000	4,610	15,900	13,000	92
	LH	37.4	133,000	42,800	16,200	18,500	17,500	2,200	1,320	5,390	219,000	4,780	18,500	13,200	87
218:1	UH	5.78	16,900	445,000	<111	21,300	2,660	<499	234	799	24,600	772	8,210	2,600	58
218:2	UH	35	167,000	58,900	1,120	55,000	9,240	4,200	1,170	32,800	156,000	3,490	11,100	162,000	101
218:4	UH	31.3	227,000	23,900	11,200	6,350	23,200	3,140	243	45,200	38,200	1,200	148,000	137,000	98

Notes:

[1] Mass balance for liquids calculated using density of 1.33 for segment 217:2 and 1.31 for segment 218:4.

[2] PO_4 data for core 217 solids are calculated from phosphorus data by ICP.

Table B3-6. Tank B-107 Charge Balance[1]

Core:Seg	Portion	Na	Bi	Cationic Charge	Cl	F	NO_3	NO_2	PO_4	SO_4	Anionic Charge	Cation/ Anion Ratio
Liquids		μg/mL		μeq/g	μg/mL						μeq/g	
217:2	DL	156,000	<40.1	6,780	2,230	723	346,000	7,780	8,430	26,800	6,920	0.98
218:4	DL	137,000	<40.1	5,960	2,440	770	315,000	5,240	19,500	21,400	6,550	0.91
Core:Seg	Portion	Na	Bi	Cationic Charge	Cl	F	NO_3	NO_2	PO_4[2]	SO_4	Anionic Charge	Cation/ Anion Ratio
Solids		μg/g		μeq/g	μg/g						μeq/g	
217:1	UH	149,000	4,810	6,550	1,230	24,500	207,000	4,530	16,600	87,600	6,730	0.97
	LH	160,000	13,600	7,150	1,210	19,300	180,000	4,560	7,410	63,800	5,260	1.36
217:2	UH	150,000	20,100	6,810	1,310	22,000	199,000	4,140	7,580	22,500	4,280	1.59
	LH	135,000	15,900	6,100	1,450	6,730	225,000	4,510	15,300	15,600	4,740	1.29
217:3	UH	129,000	21,200	5,910	1,280	6,550	216,000	4,610	15,900	13,000	4,530	1.31
	LH	133,000	16,200	6,020	1,320	5,390	219,000	4,780	18,500	13,200	4,670	1.29
218:1	UH	16,900	<111	735	234	799	24,600	772	8,210	2,600	761	0.97
218:2	UH	167,000	1,120	7,280	1,170	32,800	156,000	3,490	11,100	162,000	8,040	0.91
218:4	UH	227,000	11,200	10,000	243	45,200	38,200	1,200	148,000	137,000	9,600	1.04

Notes:

[1] Less thans and oxides from Table B3-5 are not used in the charge balance calculation.

[2] PO_4 data for core 217 solids are calculated from phosphorus data by ICP.

B3.4 MEANS AND CONFIDENCE INTERVALS

B3.4.1 Solid Data

A nested analysis of variance (ANOVA) model was fit to the solid segment data. Mean values and 95 percent confidence intervals on the mean were determined from the ANOVA. Four variance components were used in the calculations. The variance components represent concentration differences between risers, segments, laboratory samples, and analytical replicates. The model is:

$$Y_{ijkm} = \mu + R_i + S_{ij} + L_{ijk} + A_{ijkm},$$

$$I=1,2,\ldots,a;\ j=1,2,\ldots,b_i;\ k=1,2,\ldots,c_{ij};m=1,2,\ldots,n_{ijk}$$

where

Y_{ijkm}	=	concentration from the m[th] analytical result of the k[th] sample of the j[th] segment of the i[th] riser
μ	=	the mean
R_i	=	the effect of the i[th] riser
S_{ij}	=	the effect of the j[th] segment from the i[th] riser
L_{ijk}	=	the effect of the k[th] sample from the j[th] segment of the i[th] riser
A_{ijkm}	=	the analytical error
a	=	the number of risers
b_i	=	the number of segments from the i[th] riser
c_{ij}	=	the number of samples from the j[th] segment of the i[th] riser
n_{ijk}	=	the number of analytical results from the ijk[th] sample

The variables R_i, S_{ij}, and L_{ijk} are random effects. These variables, as well as A_{ijkm}, are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(R)$, $\sigma^2(S)$, $\sigma^2(L)$ and $\sigma^2(A)$, respectively.

The restricted maximum likelihood method (REML) was used to estimate the mean concentration and standard deviation of the mean for all analytes that had 50 percent or more of their reported values greater than the detection limit. The mean value and standard deviation of the mean were used to calculate the 95 percent confidence intervals. Table B3-7 gives the mean, degrees of freedom, and confidence interval for each constituent.

Some analytes had results that were below the detection limit. In these cases, the value of the detection limit was used for nondetected results. For analytes with a majority of results below the detection limit, a simple average is all that is reported.

The lower and upper limits, LL (95 percent) and UL (95 percent), of a two-sided 95 percent confidence interval on the mean were calculated using the following equation:

$$LL(95\%) = \hat{\mu} - t_{(df,\,0.025)} \times \hat{\sigma}(\hat{\mu}),$$
$$UL(95\%) = \hat{\mu} + t_{(df,\,0.025)} \times \hat{\sigma}(\hat{\mu}).$$

In this equation, $\hat{\mu}$ is the REML estimate of the mean concentration, $\hat{\sigma}(\hat{\mu})$ is the REML estimate of the standard deviation of the mean, and $t_{(df,\ 0.025)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom equals the number of risers with data minus one. In cases where the lower limit of the confidence interval was negative, it is reported as zero.

Table B3-7. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Data. (2 sheets)

Analyze	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum	ICP:A	4.09E+04	1	0.00E+00	3.29E+05	µg/g
Antimony[1]	ICP:A	<7.26E+01	n/a	n/a	n/a	µg/g
Arsenic[1]	ICP:A	<1.21E+02	n/a	n/a	n/a	µg/g
Barium[1]	ICP:A	<6.05E+01	n/a	n/a	n/a	µg/g
Beryllium[1]	ICP:A	<6.05E+00	n/a	n/a	n/a	µg/g
Bismuth[1]	ICP:A	9.85E+03	1	0.00E+00	8.07E+04	µg/g
Boron	ICP:A	3.24E+02	1	0.00E+00	1.76E+03	µg/g
Bromide[1]	IC	1.12E+03	1	0.00E+00	3.30E+03	µg/g
Cadmium[1]	ICP:A	<6.05E+00	n/a	n/a	n/a	µg/g
Calcium	ICP:A	5.49E+02	1	0.00E+00	3.61E+03	µg/g
Cerium[1]	ICP:A	1.78E+02	1	0.00E+00	4.88E+02	µg/g
Chloride	IC	9.25E+02	1	0.00E+00	5.71E+03	µg/g
Chromium	ICP:A	2.71E+02	1	0.00E+00	2.47E+03	µg/g
Cobalt[1]	ICP:A	<2.42E+01	n/a	n/a	n/a	µg/g
Copper[1]	ICP:A	2.53E+01	1	0.00E+00	1.05E+02	µg/g

Table B3-7. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Solid Segment Data. (2 sheets)

Analyze	Method	$\hat{\mu}$	df	LL	UL	Units
Fluoride	IC	1.99E+04	1	0.00E+00	1.04E+05	μg/g
Gross alpha	Alpha:F	5.67E-02	1	0.00E+00	2.54E-01	μCi/g
Iron	ICP:A	1.47E+04	1	0.00E+00	6.64E+04	μg/g
Lanthanum[1]	ICP:A	<6.05E+01	n/a	n/a	n/a	μg/g
Lead[1]	ICP:A	4.95E+02	1	0.00E+00	2.76E+03	μg/g
Lithium[1]	ICP:A	3.44E+01	1	0.00E+00	2.26E+02	μg/g
Magnesium[1]	ICP:A	2.17E+02	1	0.00E+00	1.01E+03	μg/g
Manganese	ICP:A	9.07E+01	1	0.00E+00	6.93E+02	μg/g
Molybdenum[1]	ICP:A	<6.05E+01	n/a	n/a	n/a	μg/g
Neodymium[1]	ICP:A	<1.21E+02	n/a	n/a	n/a	μg/g
Nickel[1]	ICP:A	3.70E+01	1	0.00E+00	1.33E+02	μg/g
Nitrate	IC	1.40E+05	1	0.00E+00	9.96E+05	μg/g
Nitrite	IC	3.17E+03	1	0.00E+00	2.03E+04	μg/g
Percent water	DSC/TGA	3.31E+01	1	0.00E+00	1.48E+02	%
Phosphate	IC	3.46E+04	1	0.00E+00	3.23E+05	μg/g
Phosphorus	ICP:A	2.30E+04	1	0.00E+00	1.22E+05	μg/g
Potassium[1]	ICP:A	<6.05E+02	n/a	n/a	n/a	μg/g
Samarium[1]	ICP:A	<1.21E+02	n/a	n/a	n/a	μg/g
Silicon	ICP:A	5.26E+03	1	0.00E+00	2.12E+04	μg/g
Silver[1]	ICP:A	<1.21E+01	n/a	n/a	n/a	μg/g
Sodium	ICP:A	1.40E+05	1	0.00E+00	4.96E+05	μg/g
Strontium[1]	ICP:A	1.14E+02	1	0.00E+00	9.80E+02	μg/g
Sulfate	IC	6.80E+04	1	0.00E+00	4.77E+05	μg/g
Sulfur	ICP:A	2.39E+04	1	0.00E+00	1.81E+05	μg/g
Thallium[1]	ICP:A	<2.42E+02	n/a	n/a	n/a	μg/g
Titanium[1]	ICP:A	<1.79E+01	n/a	n/a	n/a	μg/g
Uranium[1]	ICP:A	1.90E+03	1	0.00E+00	7.66E+03	μg/g
Vanadium[1]	ICP:A	<6.05E+01	n/a	n/a	n/a	μg/g
Zinc	ICP:A	2.39E+02	1	0.00E+00	5.53E+02	μg/g
Zirconium[1]	ICP:A	1.27E+02	1	0.00E+00	9.97E+02	μg/g

Note:

[1]A "less than" value was used in the calculations.

B3.4.2 Liquid Data

The model fit to the liquid data was a nested ANOVA model. The model determined the mean value and 95 percent confidence interval for each constituent (see Table B3-8). Two variance components were used in the calculations. The variance components represent concentration differences between samples taken from the two risers and between analytical replicates. The model is:

$$Y_{ij} = \mu + R_i + A_{ij},$$

$$I=1,2,\ldots,a;\ j=1,2,\ldots,n_i;$$

where

Y_{ij}	=	concentration from the j^{th} analytical result of the i^{th} riser
μ	=	the mean
R	=	the effect of the i^{th} riser
A_{ij}	=	the effect of the j^{th} analytical result of the i^{th} riser
a	=	the number of risers
n_i	=	the number of analytical results from the i^{th} riser.

The variable R_i is a random effect. This variable, along with A_{ij}, are assumed to be uncorrelated and normally distributed with means zero and variances $\sigma^2(R)$, and $\sigma^2(A)$ respectively. The *df* associated with the standard deviation of the mean is the number of risers with data minus one.

Table B3-8. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (3 sheets)

Analyze	Method	$\hat{\mu}$	df	LL	UL	Units
Aluminum[1]	ICP	<2.01E+01	n/a	n/a	n/a	μg/mL
Antimony[1]	ICP	<2.41E+01	n/a	n/a	n/a	μg/mL
Arsenic[1]	ICP	<4.01E+01	n/a	n/a	n/a	μg/mL
Barium[1]	ICP	<2.01E+01	n/a	n/a	n/a	μg/mL
Beryllium[1]	ICP	<2.00E+00	n/a	n/a	n/a	μg/mL
Bismuth[1]	ICP	<4.01E+01	n/a	n/a	n/a	μg/mL
Boron[1]	ICP	<2.01E+01	n/a	n/a	n/a	μg/mL

Table B3-8. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (3 sheets)

Analyze	Method	$\hat{\mu}$	df	LL	UL	Units
Bromide	IC	5.04E+03	1	0.00E+00	2.00E+04	µg/mL
Cadmium[1]	ICP	<2.00E+00	n/a	n/a	n/a	µg/mL
Calcium[1]	ICP	<4.01E+01	n/a	n/a	n/a	µg/mL
Cerium[1]	ICP	<4.01E+01	n/a	n/a	n/a	µg/mL
Chloride	IC	2.33E+03	1	9.98E+02	3.67E+03	µg/mL
Chromium	ICP	8.15E+01	1	0.00E+00	3.03E+02	µug/mL
Cobalt[1]	ICP	<8.02E+00	n/a	n/a	n/a	µg/mL
Copper[1]	ICP	<4.01E+00	n/a	n/a	n/a	µg/mL
Fluoride	IC	7.47E+02	1	4.48E+02	1.05E+03	µg/mL
Gross alpha[1]	Alpha rad	<2.05E-04	n/a	n/a	n/a	µCi/mL
Iron[1]	ICP	<2.01E+01	n/a	n/a	n/a	µg/mL
Lanthanum[1]	ICP	<2.01E+01	n/a	n/a	n/a	µg/mL
Lead[1]	ICP	<4.01E+01	n/a	n/a	n/a	µg/mL
Lithium	ICP	2.14E+02	1	0.00E+00	1.83E+03	µg/mL
Magnesium[1]	ICP	<4.01E+01	n/a	n/a	n/a	µg/mL
Manganese[1]	ICP	<4.01E+00	n/a	n/a	n/a	µg/mL
Molybdenum[1]	ICP	<2.01E+01	n/a	n/a	n/a	µg/mL
Neodymium[1]	ICP	<4.01E+01	n/a	n/a	n/a	µg/mL
Nickel[1]	ICP	<8.02E+00	n/a	n/a	n/a	µg/mL
Nitrate	IC	3.30E+05	1	1.30E+05	5.30E+05	µg/mL
Nitrite	IC	6.51E+03	1	0.00E+00	2.27E+04	µg/mL
Oxalate[1]	IC	<1.07E+03	n/a	n/a	n/a	µg/mL
Percent water	DSC/TGA	5.78E+01	1	4.06E+01	7.51E+01	%
Phosphate	IC	1.40E+04	1	0.00E+00	8.44E+04	µg/mL
Phosphorus	ICP	4.58E+03	1	0.00E+00	2.78E+04	µg/mL
Potassium[1]	ICP	2.06E+02	1	1.33E+02	2.79E+02	µg/mL
Samarium[1]	ICP	<4.01E+01	n/a	n/a	n/a	µg/mL
Silicon[1]	ICP	<2.01E+01	n/a	n/a	n/a	µg/mL
Silver	ICP	1.10E+01	1	3.03E+00	1.89E+01	µg/mL
Sodium	ICP	1.46E+05	1	2.58E+04	2.67E+05	µg/mL

Table B3-8. 95 Percent Two-Sided Confidence Interval for the Mean Concentration for Liquid Sample Data. (3 sheets)

Analyze	Method	$\hat{\mu}$	df	LL	UL	Units
Specific gravity	SpG	1.33E+00	1	1.13E+00	1.53E+00	unitless
Strontium[1]	ICP	<4.01E+00	n/a	n/a	n/a	µg/mL
Sulfate	IC	2.41E+04	1	0.00E+00	5.90E+04	µg/mL
Sulfur	ICP	9.30E+03	1	0.00E+00	2.39E+04	µg/mL
Thallium[1]	ICP	<8.02E+01	n/a	n/a	n/a	µg/mL
Titanium[1]	ICP	<4.01E+00	n/a	n/a	n/a	µg/mL
Uranium[1]	ICP	<2.00E+02	n/a	n/a	n/a	µg/mL
Vanadium[1]	ICP	<2.01E+01	n/a	n/a	n/a	µg/mL
Zinc[1]	ICP	<4.01E+00	n/a	n/a	n/a	µg/mL
Zirconium[1]	ICP	<4.01E+00	n/a	n/a	n/a	µg/mL

Note:

[1]A "less than" value was used in the calculations.

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

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APPENDIX C

STATISTICAL ANALYSIS FOR ISSUE RESOLUTION

C1.0 STATISTICS FOR THE SAFETY SCREENING DATA QUALITY OBJECTIVE

The safety screening DQO (Dukelow et al. 1995) defines decision limits in terms of one-sided 95 percent confidence intervals. The safety screening DQO limits are 41 μCi/g for gross alpha and 480 /g for DSC.

Confidence intervals were calculated for the mean value of each laboratory sample. The data used was from the data package of the 1997 core sampling event (Nuzum 1997). Table C1-1 has the gross alpha results. No exotherms were observed in any DSC sample.

The upper limit (UL) of a one-sided 95 percent confidence interval on the mean is

$$\hat{\mu} + t_{(df,0.05)}\,\hat{\sigma}_{\hat{\mu}}.$$

In this equation, $\hat{\mu}$ is the arithmetic mean of the data, $\hat{\sigma}_{\hat{\mu}}$ is the estimate of the standard deviation of the mean, and $t_{(df,0.05)}$ is the quantile from Student's t distribution with *df* degrees of freedom. The degrees of freedom equals the number of samples minus one.

Table C1-1 shows the upper limit of a 95 percent confidence interval for sample numbers with at least one value above the detection limit. Each confidence interval can be used to make the following statement. If the upper limit is less than 41 μCi/g (61.5 μCi/mL for drainable liquid), reject the null hypothesis that the alpha is greater than or equal to 41 μCi/g (61.5 μCi/mL for drainable liquid) at the 0.05 level of significance.

Seventeen of 22 gross alpha results were above the detection limit. The UL closest to the threshold was 1.26E-01 μCi/g, for core 217, segment 1. This is well below the limit of 41 μCi/g. No DSC result had an exothermic reaction.

Table C1-1. 95 Percent Upper Confidence Limits for Gross Alpha.

Lab Sample ID	Description	$\hat{\mu}$	df	UL	Units
S97T002077[1]	Core 217, segment 2, subsample	2.46E-04	1	3.76E-04	μCi/mL
S97T002087F	Core 217, segment 1, lower half	8.53E-02	1	1.26E-01	μCi/g
S97T002090F	Core 217, segment 1, upper half	6.32E-02	1	1.10E-01	μCi/g
S97T002093F	Core 217, segment 2, lower half	7.52E-02	1	9.31E-02	μCi/g
S97T002096F	Core 217, segment 2, upper half	8.17E-02	1	8.68E-02	μCi/g
S97T002099F	Core 217, segment 3, lower half	4.44E-02	1	4.48E-02	μCi/g
S97T002102F	Core 217, segment 3, upper half	7.65E-02	1	9.86E-02	μCi/g
S97T002119F	Core 218, segment 2, upper half	2.92E-02	1	3.36E-02	μCi/g
S97T002122F	Core 218, segment 4, upper half	5.07E-02	1	1.07E-01	μCi/g

Note:

[1]A "less than" value was used in the calculations.

C2.0 APPENDIX C REFERENCES

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-107

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APPENDIX D

EVALUATION TO ESTABLISH BEST-BASIS INVENTORY FOR SINGLE-SHELL TANK 241-B-107

An effort is underway to provide waste inventory estimates that will serve as standard characterization source terms for waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of available information for single-shell tank 241-B-107 was performed, and a best-basis inventory was established. This work, detailed in the following sections, follows the methodology that was established by the standard inventory task.

D1.0 CHEMICAL INFORMATION SOURCES

Appendix B provides characterization results from the most recent sampling event for this tank. Two core samples (cores 217 and 218) were obtained in 1997 from two different risers. Sample inventories were derived as described in Section D3.5. The analytical data from core samples from tanks 241-BX-112, 241-C-110, 241-BX-107, 241-T-104 and 241-T-107, which historically contain the same $BiPO_4$ process first cycle waste type as tank 241-B-107; data from tanks 241-B-104, 241-B-106, 241-B-108, and 241-B-109, whose process records indicate the tanks received similar transfers of salt-bearing waste; and data from tanks 241-B-109, 241-S-111, and 241-U-110, which also contain a high-aluminum waste layer; provided useful comparison information. The HDW model (Agnew et al. 1997a) also provides tank content estimates in terms of component concentrations and inventories.

D2.0 COMPARISON OF COMPONENT INVENTORY VALUES

Table D2-1 compares sample-based inventories derived from the analytical data for solids (see Table B3-7) and HDW model inventories (Agnew et al. 1997a). The tank volume used to generate these inventories is 625 kL (165 kgal). The volume reported in Hanlon (1997) is the same as that used by Agnew et al. The chemical species in this appendix are reported without charge designation according to the best-basis inventory convention. The previous best-basis estimate, derived before the availability of 1997 core sample data, is also shown. Because no individual radionuclide analyses were performed on the core samples, no comparison of radionuclide estimates is provided. Some analytes, notably bismuth, iron, and phosphate, are comparable for the sample-based and HDW model inventory estimates. However, many key analytes are not close. The sample-based estimates for aluminum, fluoride, sodium, nitrate, and sulfate are higher than the HDW estimates by approximately a factor of two or higher. Uranium is less than 10 percent of the HDW estimate. The existence of saltcake in the tank and the difference in the density and water estimates probably accounts for most of the differences. With a density of 1.64 g/mL and 34 weight percent water, a water-free concentration of 1.08 g/mL can be calculated for the sample based data. With a density of 1.38 g/mL and 64.2 weight percent water, a water-free concentration of 0.49 g/mL is calculated for the HDW data. Therefore, the sample-based inventory data could be expected to be higher than the HDW data by approximately a factor of 2.

Table D2-1. Inventory Estimates for Nonradioactive Components in Tank 241-B-107. (2 sheets)

Analyte	Sample-based Inventory[1] (kg)	HDW Model Inventory Estimate[2] (kg)	Previous Best-Basis Inventory[3] (kg)
Al	42,000	10,000	13,000
Bi	10,100	8,090	14,500
Ca	560	1,900	1,080
Cl	946	681	782
Cr	277	157	690
F	20,400	1,640	8,260
Fe	15,000	12,200	12,500
Hg	n/r	13.2	<0.28
K	<621	163	234
La	<62	0	<31
Mn	93	0	123
Na	143,000	74,600	80,200
Ni	38	43.6	60
NO_2	3,250	6,750	11,000
NO_3	144,000	39,900	79,200
PO_4	72,100	67,900	66,600
Pb	507	0.251	260
Si	5,380	3,900	6,100
SO_4	69,600	3,100	8,080
Sr	117	0	259
TIC as CO_3	n/r	2,840	7,300
TOC	n/r	0.108	817

Table D2-1. Inventory Estimates for Nonradioactive Components in Tank 241-B-107. (2 sheets)

Analyte	Sample-based Inventory[1] (kg)	HDW Model Inventory Estimate[2] (kg)	Previous Best-Basis Inventory[3] (kg)
U_{TOTAL}	1,950	30,000	5,480
Zr	130	13.5	98
H_2O (wt%)	34	64.2	n/r

Notes:

[1]Based on analytical data for tank 241-B-107 solids (see Table B3-7), a density of 1.64 g/mL, and a waste volume of 625 kL (165 kgal)

[2]Agnew et al. (1997a)

[3]Kupfer (1997)

D3.0 COMPONENT INVENTORY EVALUATION

The following evaluation of tank contents is performed to identify potential errors and/or missing information that would influence the sample-based and HDW model component inventories.

D3.1 CONTRIBUTING WASTE TYPES

The following abbreviations were used to designate waste types:

1C = First decontamination cycle $BiPO_4$ process waste (also contains some cladding waste which was used to neutralize the 1C waste)

1C1 = First decontamination cycle $BiPO_4$ process waste (1944 to 1949)

1C2 = First decontamination cycle $BiPO_4$ process waste (1950 to 1956)

BSltCk = Saltcake from 241-B Evaporator operation (1951 to 1953)

EB = Evaporator bottoms, a slurry product from the evaporators that is comparable to BSltCk

CW = $BiPO_4$ process aluminum cladding waste

CWP = Plutonium-uranium extraction (PUREX) process aluminum cladding waste

D3.1.1 Waste Transaction History and Current Predicted Waste Types

Tank 241-B-107 is the first tank in a cascade that includes tanks 241-B-108 and 241-B-109. Tank 241-B-107 began receiving 1C waste combined with CW from B Plant in 1945. Cascading of waste from tank 241-B-107 into tank 241-B-108 began in 1945 (Anderson [1990] and Agnew et al. [1997b]).

Waste supernatant was sent from tank 241-B-107 to tank 241-B-106 in 1952. Tank 241-B-106 was the feed tank for the 242-B Evaporator at this time. Evaporator bottoms were received from tank 241-B-106, and BSltCk waste solids were formed through 1954. The PUREX cladding waste supernatants were transferred to tank 241-B-107 in 1963.

Based on this process history, the majority of the solids expected in tank 241-B-107 consists of first cycle (1C/CW) solids from the $BiPO_4$ process operations performed at B Plant in 1944 to 1946. Although 1C evaporator bottoms were received from tank 241-B-106 beginning in 1952 through 1954, it is expected that most liquids were removed in 1957 for ferrocyanide scavenging operations that removed ^{137}Cs. Although some saltcake still remains in the tank, the volume is uncertain.

Cladding waste supernatants were received from tanks 241-C-101, 241-C-102, 241-C-103, and 241-C-106 in 1963, however, few solids are expected to have accumulated in tank 241-B-107 because these solids probably precipitated and settled in C Tank Farm tanks. Aluminum can precipitate from cladding waste supernatants because of changes in pH.

Agnew et al. (1997a) predicts that tank 241-B-107 contains 621 kL (164 kgal) of 1C1 waste and 4 kL (1 kgal) of supernatant. The sort on radioactive waste type model (Hill et al. 1995) lists 1C, EB, and CW as the primary, secondary, and tertiary waste types respectively that entered the tank. No quantitative estimate was noted for each contributing waste type. Hanlon (1997) reports that the tank contains 621 kL (164 kgal) of sludge and 4 kL (1 kgal) of supernatant.

Examination of the core sample data in Table B3-5 indicates the core 217 data are consistent with the 1C waste predicted to be in the tank. Segment 218-1 is dry and very high in aluminum, and it appears to be a distinct phase. Segments 218-2 and 218-4 contain a high percent of soluble cations and anions and, therefore, are assumed to consist of BSltCk.

A volume estimate of 310 kL (82 kgal), or half the tank solids, was chosen for the 1C waste represented by core 217. The remaining half of the tank was divided between high aluminum and BSltCk phases. The analytical data for sample 218-1 is used as the basis for the top 10 cm (4 in.) of waste for the eastern half of the tank represented by core 218. This corresponds to

42 kL (11 kgal) of waste. This assumption is somewhat arbitrary as 25 cm (10 in.) of waste was expected for segment 218-1, but only 2.5 cm (1 in.) of solids was recovered. The remaining 269 kL (71 kgal) of waste is assumed to be BSltCk. The small volume of supernatant (4 kL [1 kgal]) estimated by Hanlon (1997) was not included in the best-basis inventory estimate.

D3.2 BASIS FOR ASSESSING 1C WASTE IN TANK 241-B-107

An estimate of the composition of the 1C sludge layer can be made by comparing the sludge layer of tank 241-B-107 to other tanks containing 1C sludge. In the $BiPO_4$ process from 1944 through 1954, the 1C waste was combined with the CW stream before being discharged from the plant (Anderson 1990).

Several tanks received 1C/CW waste directly from T Plant including tanks 241-T-104, 241-T-107, 241-TX-109, 241-TX-113, 241-U-110, 241-TY-101, and 241-TY-103. Sample data are not available for the solid layers of tanks 241-TX-109, 241-TX-110, or 241-TX-113. The 1C waste was mixed with substantial quantities of other wastes in tanks 241-TY-101, 241-TY-103, and 241-U-110 making it difficult to accurately determine the composition of the 1C/CW waste sludge. Tanks 241-T-104 and 241-T-107 provide some of the best examples of T Plant 1C/CW sludge composition.

Several other tanks received 1C/CW waste directly from the B Plant $BiPO_4$ process 1C operations. These tanks included 241-C-110 (Benar 1997b), 241-BX-112 (Kupfer and Winward 1997b), 241-BX-110 (Kupfer and Winward 1997a), and 241-BX-107 (Winkelman 1997). Tanks 241-C-110, 241-BX-107, and 241-BX-112 are the best examples of B Plant 1C/CW waste because these tanks contain 1C/CW waste almost exclusively, and analyses of core samples are available for these tanks. Insufficient tank sample analyses are available in tank 241-BX-110 to compare for 1C/CW waste. Calculations show that the composition of the B Plant 1C waste and the T Plant 1C waste are consistent with the flowsheet basis (Schneider [1951] and Kupfer et al. [1997]) for the first cycle $BiPO_4$ process, and no significant plant to plant differences exist. The relative concentrations of components expected to precipitate 100 percent to the waste solids (for example, Bi, Fe, Si, Zr) are consistent (up to a factor of three) between the samples, and are approximately proportionate to the relative 1C flowsheet concentrations for those components (see Appendix C of Kupfer et al. 1997). Therefore, it can be concluded that the sample data for these tanks are consistent with the flowsheet basis. In addition, the concentrations of components that partition between solids and supernatants are comparable between the tanks and represent expected chemical behavior. Kupfer et al. (1997) describe the process for applying component concentration factors for reconciling process-based flowsheet compositions and sample data to determine the consistency of the sample and the flowsheet basis.

The composition of waste in tanks 241-T-104, 241-T-107, 241-BX-112, 241-BX-107, and 241-C-110, based on the respective TCRs (Sasaki [1997a and 1997b], Kupfer and Winward

[1997b], Winkelman [1997], and Benar [1997b]), are compared to the composition of core 217 from tank 241-B-107 in Table D3-1. Also shown for comparison, is the 1C defined waste from Agnew et al. (1997a). The data in Table D3-1 are not corrected for water because the water content of the samples and the HDW model composition were considered close enough for a direct comparison.

An examination of the data from the tanks listed in Table D3-1 reveals that the core 217 average results from tank 241-B-107 are significantly higher in NO_3 and SO_4, slightly higher in Na and density, and slightly lower in moisture than any other tanks. However, the agreement is excellent overall.

D3.3 BASIS FOR ASSESSING HIGH ALUMINUM LAYER IN TANK 241-B-107

Although tank 241-B-107 was expected to contain only 1C solids, the top sample from core 218 contains approximately 15 weight percent aluminum. This dominant aluminum signature indicates the waste is probably derived from cladding waste. Matheison and Nicholson (1968) provide the PUREX process flowsheet basis for the neutralized aluminum cladding waste. The major components include Na, Al, Si, NO_2, and NO_3. Table D3-2 shows the analyte concentrations (on a water-free basis) for segment 218-1 from tank 241-B-107. The cladding waste from tank 241-B-109 and the defined waste composition for CWP2 from the HDW model are also shown. The comparison with the tank 241-B-109 waste is generally not good. However, tank 241-B-109 waste is considered to be 50 percent saltcake, and the significant levels of uranium suggest that some fuel core material also is present. The comparison to tank 241-S-111 and the flowsheet and HDW model assumptions for cladding waste also is not good. However, it may be that supernatant pumping would have removed the highly soluble species (Na, NO_3, NO_2) resulting in the depleted concentrations observed in the sample. The high concentration of aluminum in this sample is comparable to that for the HDW model- defined waste CWP2. The HDW model CWP2 defined waste does not indicate silicon, whereas measurable concentrations of silicon were found in the core sample. The presence of silicon in aluminum cladding waste is expected because the decladding process attacks the aluminum-silicon alloy bonding. It is not clear why the HDW model does not indicate silicon for the defined waste.

The mass balance for segment 218-1 was poor (see Section B3.2.2). Only acid digestion ICP analyses were performed. With this type of sample, a fusion digestion would likely result in higher concentrations for metals such as Al, Cr, Na, and Si. Nevertheless, the results for this sample are within the range of other samples and the HDW model estimate listed in the table, except for Fe (slightly above the model estimate), Cr (slightly below), and NO_2 (well below the other data). Overall, the results are consistent with cladding waste from which highly soluble species such as Na, NO_2, and NO_3 have been depleted. A similar scenario was proposed for the tank 241-U-110 top layer as well, which had a much higher aluminum concentration relative to other analytes (Brown and Jensen 1993).

Table D3-1. Component Concentrations for 1C/CW Waste in Tanks 241-BX-107, 241-BX-112, 241-C-110, 241-T-104, 241-T-107, and 241-B-107. (3 sheets)

Analyte	BX-107[1]	BX-112[2]	C-110[3]	T-104[4]	T-107[5]	Average conc.	B-107 Core 217	HDW Model 1C1[6]
Chemical	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g
Ag	<0.942	<46.4	<0.690	<1.09	7.37	<11.3	<10	n/r
Al	14,300	13,600	14,300	16,200	16,400	15,000	21,000	11,700
Bi	22,300	17,500	13,500	18,900	11,200	16,700	15,300	9,440
Ca	396	2,510	<385	1,450	1,500	1,250	735	2,210
Cd	2.27	<59.5	5.20	5.44	6.40	<15.8	<5	n/r
Cl	1,140	1,050	1,090	670	547	899	1,300	794
CO_3	5,800	10,500	10,500	<500	14,800	8,430	n/r	3,310
Cr	968	1,290	464	901	354	795	442	183
F	9,190	10,700	7,590	8,570	11,500	9,510	14,100	1,912
Fe	11,100	9,460	10,700	9,020	31,500	14,400	12,200	14,300
Hg	0.565	n/r	0.446	<0.125	0.134	<0.318	n/r	15.4
K	263	406	559	89.0	31.6	270	<497	190
La	<1.51	<156	7.69	<10.2	<2	<35.5	<50	0
Mn	64.6	323	35.8	61.8	222	141	44	0
Na	102,000	81,800	82,800	64,500	130,000	92,300	143,000	87,000
Ni	12.2	<2.76	<24.2	11.3	292	68.5	40	50.8
NO_2	12,300	25,600	9,290	4,080	11,800	12,600	4520	7,860

Table D3-1. Component Concentrations for 1C/CW Waste in Tanks 241-BX-107, 241-BX-112, 241-C-110, 241-T-104, 241-T-107, and 241-B-107. (3 sheets)

Analyte	BX-107[1]	BX-112[2]	C-110[3]	T-104[4]	T-107[5]	Average conc.	B-107 Core 217	HDW Model 1C1[6]
Chemical	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g
NO_3	137,000	75,100	110,000	58,000	75,400	91,100	208,000	46,500
Pb	62.8	<331.0	258	49.8	796	300	330	0
P as PO_4	71,700	59,200	62,600	75,700	114,000	76,600	78,500	79,200
Si	6,780	8,400	7,160	6,520	6,070	6,990	6,030	4,550
S as SO_4	13,700	6,480	11,900	3,840	10,600	9,290	36,000	3,620
Sr	168	132	130	99.1	962	298	181	0
TOC	798	959	<676	<570	1,700	941	n/r	0
U	4,838	1,040	2,140	897	22,600	6,300	1,740	35,100
Zr	136	<78.1	172	67.5	113.0	113	192	15.8
Density (g/mL)	1.44	1.31	1.45	1.29	1.51	1.40	1.63	1.38
H_2O (wt %)	59	63.7	60.2	70.5	46.0	59.9	42.2	64.0

Table D3-1. Component Concentrations for 1C/CW Waste in Tanks 241-BX-107, 241-BX-112, 241-C-110, 241-T-104, 241-T-107, and 241-B-107. (3 sheets)

Analyte	BX-107[1]	BX-112[2]	C-110[3]	T-104[4]	T-107[5]	Average conc.	B-107 Core 217	HDW Model 1C1[6]
Radionuclide	µCi/g	µCi/g	µCi/g	µCi/g	µCi/g	µCi/g	µCi/g	µCi/g
^{241}Am	0.013	<0.167	<0.00953	<0.0173	<0.0722	<0.056	n/r	2.20E-05
^{14}C	2.60E-04	n/r	3.20E-04	<4.5E-05	<1.91E-04	<2.0E-04	n/r	6.3E-05
^{60}Co	<0.0057	<0.0122	<0.0297	<2.18E-04	<0.0132	<0.012	n/r	8.7E-06
^{137}Cs	16.9	51.8	18.8	0.193	12.1	20.0	n/r	6.21
^{154}Eu	<0.015	<0.0336	<0.0827	0.00295	<0.0497	<0.037	n/r	1.2E-04
^{155}Eu	<0.029	<0.168	<0.091	0.00288	<0.0586	<0.070	n/r	9.3E-04
$^{239/240}$Pu	0.0572	n/r	0.0800	0.14	0.15	0.107	n/r	0.0129
^{90}Sr	9.58	6.05	4.76	2.55	106	25.8	n/r	5.51
^{99}Tc	0.0369	n/r	0.0330	<6.30E-04	<0.0505	<0.030	n/r	4.3E-04

Notes:

[1]Winkelman (1997)
[2]Kupfer and Winward (1997b)
[3]Benar (1997b)
[4]Sasaki (1997a)
[5]Sasaki (1997b)
[6]1C1 defined waste (Agnew et al. 1997a)

Table D3-2. Chemical Compositions of Cladding and High Aluminum Wastes.[1]

Analyte	241-B-107 Segment 218-1 UH μg/g	241-B-109[2] μg/g	241-S-111[3] μg/g	241-U-110[4] μg/g	HDW model CWP2[5] μg/g
Al	163,000	189,264	280,000	92,300	213,700
Bi	<118	<3,720	38	559	0
Ca	307	<3,650	182	n/r	17,410
Cr	23	5,692	2,520	n/r	164
Fe	14,200	8,962	53	913	34,500
K	<530	n/r	487	n/r	101
La	<53	<1,664	n/r	n/r	0
Mn	75	1,069	235	n/r	0
Na	17,900	281,149	77,700	2,130	38,430
Ni	21	3,084	15	n/r	93
Pb	828	<3,320	n/r	n/r	91,250
Si	1,040	9,378	472	n/r	0
Sr	11	<331	4	n/r	0
U	530	42,586	n/r	400	55,500
Zr	11	<331	4	n/r	0
CO_3	n/r	n/r	n/r	n/r	26,100
Cl	248	1,463	2,360	n/r	422
F	848	11,762	69	32	0
NO_3	26,000	101,069	39,700	250	43,320
NO_2	819	20,668	23,800	n/r	13,950
PO_4	8,710	163,691	1,780	200	0
SO_4	2,760	3,115	794	n/r	1,249

Notes:

[1]Water-free basis
[2]Benar (1997b), core 169
[3]Conner (1997), core 149, segments 10 and 11
[4]Bell (1997), average of segment 1 from several cores
[5]Agnew et al. (1997a)

In-tank photographs indicate that the surface of the eastern half of the tank is light-colored and dry. The analytical data for sample 218-1 is used as the basis for the top 10 cm (4 in.) of waste for the eastern half of the tank represented by core 218. This corresponds to 42 kL (11 kgal) of waste. This assumption is somewhat arbitrary as 25 cm (10 in.) of waste were expected for segment 218-1, yet only 2.5 cm (1 in.) of solids were recovered.

D3.4 BASIS FOR ASSESSING SALTCAKE INVENTORIES IN TANK 241-B-107

The abbreviation, BSltCk, is used by Agnew et al. (1997b) to represent salt waste supernatants that were evaporated and concentrated in the 242-B Evaporator until they were largely solidified. Although tank 241-B-107 was expected to contain only 1C solids, Appendix B data indicate core 218 does not resemble 1C waste. This section compares data from the second and fourth segments of this core to BSltCk. Agnew et al. (1997b) provides a single average composition for the BSltCk defined waste. However, historical records (Anderson [1990] and Agnew et al. [1997b]) indicate that supernatants from the first cycle bismuth phosphate process (1C waste) and supernatants from the uranium recovery process were evaporated in the 242-B Evaporator and transferred to several tanks in the 241-B Tank Farm. The chemical compositions of the dilute supernatants from these processes differed. Because the supernatants were not all blended together before evaporation, the saltcake compositions resulting from evaporation of these wastes are expected to differ as a function of position within a tank and as a function of which tank was used as a receiver at a particular time.

Because of the complicated waste supernatant transfer history of feed to the 242-B Evaporator and the lack of a flowsheet basis for the waste, it is difficult to perform an independent assessment to estimate the saltcake composition that can be compared to the model-based BSltCk composition. However, waste samples from a limited number of B Tank Farm tanks, expected to contain BSltCk, have been analyzed and reported. Table D3-3 summarizes the composition data for tanks 241-B-104 (Field and Higley 1997), 241-B-106 (Higley and Field 1997), 241-B-108 (Schreiber 1997), and 241-B-109 (Benar 1997a). The analytical results for these tanks were evaluated at the core segment level to identify the areas representing BSltCk. Data from segments 2 and 4 of core 218 from tank 241-B-107 are also shown. The core 218, segment 1, data are not shown because this sample does not resemble saltcake; the core 217 data are not shown because this core is assumed to contain primarily 1C waste.

To provide a common basis for comparison of the data in Table D3-3, the reported water mass was removed from the results (that is, the results are compared on a water-free basis). Table D3-3 includes the HDW model composition for BSltCk (also on a water-free basis) for comparison.

Table D3-3. Composition of 242-B Evaporator Saltcake (Water-Free Basis). (2 sheets)

Analyte	B-104[1]	B-106[2]	B-108[3]	B-109[4]	B-107		HDW Model[5] BSltCk
					C218 S2 UH	C218 S4 UH	
	$\mu g/g$	$\mu g/g$	$\mu g/g$	$\mu g/g$	$\mu g/g$	$\mu g/g$	$\mu g/g$
Al	3,471	6,925	40,400	40,380	31,300	12,000	432
Bi	21,516	7,238	<3,130	6,808	1,716	16,200	3,818
Ca	618	4,499	<3,020	<2,950	476	535	2,894
Cr	966	666	355	1,420	235	164	290
Fe	19,857	35,011	<1,570	5,908	53,200	5,800	6,666
K	n/r	315	1,900	n/r	<1,510	<1,430	599
La	n/r	<73	<1,570	<1,475	<151	<143	0
Mn	n/r	403	<302	<295	472	54	0
Na	220,620	228,337	343,560	417,902	256,000	330,000	295,250
Ni	n/r	129	n/r	n/r	<60	<57	500
Pb	n/r	741	<3,020	<3,023	369	1,520	0
Si	10,729	4,092	2,051	2,236	5,250	12,400	1,170
Sr	n/r	911	<302	<295	51	134	0
U	3,616	27,821	1,930	<14,750	5,060	3,580	15,900
Zr	n/r	<73	<302	<295	67	163	13.9
CO_3	n/r	1,625	6,925	n/r	n/r	n/r	11,480
Cl	3,974	3,334	1,471	1,495	1,800	353	3,030
F	6,516	5,632	61,280	79,614	50,500	65,700	1,979
NO_3	546,139	409,639	114,590	219,962	240,000	55,600	547,100
NO_2	4,614	16,044	19,275	7,907	5,380	1,750	11,150
PO_4	43,879	66,436	182,070	125,628	17,100	215,000	95,690
SO_4	41,153	31,312	183,700	316,880	249,000	199,000	12,770

Table D3-3. Composition of 242-B Evaporator Saltcake (Water-Free Basis). (2 sheets)

Analyte	B-104[1]	B-106[2]	B-108[3]	B-109[4]	B-107		HDW Model[5] BSltCk
					C218 S2 UH	C218 S4 UH	
Radionuclide	μCi/g	μCi/g	μCi/g	μCi/g	μCi/g	μCi/g	μCi/g
^{137}Cs	n/r	50.5	23.5	n/r	n/r	n/r	49.0
^{90}Sr	n/r	149	3.3	n/r	n/r	n/r	12.5

Notes:

[1]Field and Higley (1997)

[2]Higley and Field (1997)

[3]Schreiber (1997). Data from upper half segment 1 from cores 172 and 173 are not included because these partial segments contain primarily CW.

[4]Benar (1997a). Core 170. Core 169 data are not show because this core contained primarily CW.

[5]Agnew et al. (1997a)

When compared to data from other tanks, obvious outliers among the tank 241-B-107 samples are the high Fe result for segment 2 and the low NO_3 result for segment 4. The tremendous variability between the two samples from tank 241-B-107 also is problematic, for example, the two PO_4 results are the extreme low and high values for all samples listed. It may be that the low recovery for these segments and the fact that these are single sample results rather than averages of several samples, account for some of this variability. Nevertheless, the concentrations of most of these analytes for segments 2 and 4 of core 218 appear to fall within the range of the results for BSltCk for these other tanks.

Even given the bias and variability of the samples, these analytical results for segments 2 and 4 of core 218 are considered to be the best estimate of the waste concentrations in this region of tank 241-B-107. The liquid data is ignored as it is attributed almost exclusively to the intrusion of HHF, as reported in Appendix B (see Section B3.1). Data from the two solid subsamples are used to estimate the chemical inventory for half the tank, less the 10 cm (4 in.) surface layer described in Section D3.3. The volume of waste estimated by these samples is 269 kL (71 kgal). Gaps in the analytical data are filled in using the average values from the other tanks listed in Table D3-1 (corrected using the average moisture content for the core 218 samples of 33.2 percent and a density of 1.7 g/mL).

D3.5 ESTIMATED CHEMICAL INVENTORY FOR TANK 241-B-107

Table D3-4 lists the chemical inventory for the 1C sludge, high aluminum cladding waste, and BSltCk components in tank 241-B-107. The inventories estimated by the HDW model for the tank (Agnew et al. 1997a) are included for comparison.

The estimated inventory for the 1C waste components for tank 241-B-107 was calculated as the product of the average component concentrations for core 217 from Appendix B (see Section B2.4 data tables), a waste volume of 310 kL (82 kgal), and the average density for core 217 of 1.63 g/mL. Gaps in the inventory were filled in using the average composition estimates in Table D3-1. If the sample results were below detection limits, the engineering estimate was used (if available).

The estimated chemical inventory for the high aluminum cladding waste was calculated as the product of the component concentrations for segment 218-1 from Appendix B (see Section B2.4 data tables) , a waste volume of 42 kL (11 kgal), and a density of 1.71 g/mL taken from tanks 241-U-110 (1.64), 241-S-111 (1.65), and 241-B-109 (1.85) because no density result was available for the sample from segment 218-1. Gaps in the data were not filled in because of the lack of a good estimate for this waste layer and the small volume relative to the rest of the waste (6.7 percent). Most major analytes were covered by the analyses.

The estimated inventory for BSltCk waste was calculated as the product of the average component concentrations for the segments 218-2 and 218-4 from Appendix B (see Section B2.4 data tables), a waste volume of 269 kL (71 kgal), and a density of 1.7 g/mL. Gaps in the data for tank 241-B-107 were filled in using the average composition for the other tanks listed in Table D3-3, corrected to account for the moisture content of segments 218-2 and 218-4 (33.2 percent). If the sample results were below detection limits, the engineering estimate was used (if available). There was no attempt to estimate the composition of the 4 kL (1 kgal) supernatant estimated to be in the tank because the overall contribution of the total mass of tank components in the supernatant is considered inconsequential. Comparison of the inventory estimates indicates that the sampling inventory is much higher than the HDW model inventory for aluminum, fluoride, sodium, nitrate, and sulfate; and much lower for uranium. This is consistent with the assumption that the tank contains a substantial amount of saltcake and less 1C than the HDW model predicts.

Several adjustments to the inventory shown in Table D3-4 need to be made based on knowledge of process history. All sample results for lanthanum were below detection limits. Although engineering estimates for lanthanum are reported in Tables D3-1 and D3-3, the data for all but one tank used to generate the estimates are also below detection limits. As lanthanum is not expected in this tank based upon process history, the lanthanum inventory is assumed to be zero.

A second adjustment needs to be made for mercury. Mercury inventories for each tank recently have been calculated based on process history (Simpson 1998). The estimate given for tank 241-B-107 is 52.25 kg of mercury.

Table D3-4. Estimated Chemical Inventory for Tank 241-B-107.[1] (2 sheets)

Analyte	1C	High Al/CW	BSltCk	Total Tank	HDW Model[2]
Al	10,600	11,000	6,550	28,100	10,000
Bi	7,740	<8	2,810	10,600	8,090
Ca	372	21	155	547	1,900
Cl	658	17	323	997	681
TIC as CO_3	3,660	n/r	1,300	4,970	2,840
Cr	224	1.51	61	286	157
F	7,130	57	17,800	25,000	1,640
Fe	6,170	950	8,820	15,900	12,200
Hg	<0.138	n/r	n/r	0.138	13.2
K	137	<36	338	510	163
La	<25	<3.55	45	<73.6	0
Mn	22	5.05	79	106	0
Na	72,300	1,200	90,000	164,000	74,600
Ni	20	1.42	18	40	43.6
NO_2	2,290	55	1,070	3,410	6,750
NO_3	105,000	1,749	44,400	151,000	39,900
OH_{TOTAL}	n/r	n/r	n/r		42,900
Pb	167	56	292	515	0.251
PO_4	39,700	584	36,300	76,600	67,900
Si	3,050	70	2,730	5,850	3,900
SO_4	18,200	185	68,300	86,700	3,100
Sr	92	0.710	29	121	0
TOC	408	n/r	n/r	408	0.108
U_{TOTAL}	880	36	1,310	2,230	30,000
Zr	97	0.710	36	133	13.5

Notes:
[1]All data are in kilograms.
[2]Agnew et al. (1997a)

D3.6 ESTIMATED RADIONUCLIDE INVENTORY FOR TANK 241-B-107

The core samples from tank 241-B-107 were not analyzed for individual radionuclides. In addition, the prediction that the tank contains predominantly 1C waste is not well supported by the analytical results. For this reason, the HDW model prediction is not considered an appropriate estimate. Different sources of data were used to estimate the radionuclide inventories.

Uranium isotopes are estimated using the uranium inventory estimate from Table 3-4 and the isotopic ratios from the HDW estimate for tank 241-B-107. The calculation of the uranium inventories is provided in Table D3-5.

Plutonium, americium, and curium isotopes were considered to be significant alpha contributors, and were calculated by ratio from HDW values using the analytical results for total alpha activity. To accomplish this, the total alpha activity for the tank was calculated. The waste layers that were assumed for the chemical inventory calculation (see Section D3-5) needed to be modified because no total alpha result was available for segment 218-1, the high aluminum/CW layer. Given the relatively small volume (42 kL [11 kgal]) of this phase and because the rest of this core is BSltCk, it was assumed the total alpha concentration of this phase is identical to BSltCk. Therefore, the combined volume of 310 kL (82 kgal) was used for BSltCk. Table D3-6 shows the calculation of the total alpha inventory.

Subtracting the inventory for all uranium isotopes (see Table D3-5) from the inventory of all alpha emitting radionuclides (see Table D3-6) produces an estimate of the net alpha inventory. Inventories for the non-uranium alpha contributors can be calculated by ratio from the HDW isotopic values. Finally, ^{241}Pu (not an alpha emitter) can be calculated from the HDW estimate using the ratio to another Pu isotope (^{240}Pu was used). Table D3-5 shows these results.

The remainder of the radionuclides are estimated using data from other tanks. The 1C waste is estimated from the engineering estimate (see Table D3-1), if available, or from the best-basis inventories from tanks 241-BX-107, 241-BX-112, 241-C-110, 241-T-104, and 241-T-107. The BSltCk waste is estimated from the engineering estimate, if available (see Table D3-3) or from the best-basis inventories from tanks 241-B-104, 241-B-106, 241-B-108, and 241-B-109. As no data from other tanks are considered to be representative of the high aluminum/CW phase in tank 241-B-107, the radionuclide composition of this phase is assumed to be the same as BSltCk. Therefore, as was the case with total alpha inventory calculation, a combined volume of 310 kL (82 kgal) was used for BSltCk. Table D3-8 shows a sample calculation for ^{63}Ni and ^{137}Cs. The ^{226}Ra inventory for tank 241-B-106 and the ^{237}Np inventory for tank 241-T-104 were very high compared to other tanks of the same waste type. Because these high results are not typical of the waste type, they were excluded from the calculations.

Table D3-5. Inventory Calculation for Uranium Isotopes for Tank 241-B-107.

	Specific Activity (Ci/g)	HDW Model Values[1]		Adjusted Values[2]	
		(kg)	(Ci)	(kg)	(Ci)
Total	n/a	30,000	20.4	2,230	1.52
U-232	21.4	7.29E-09	1.56E-04	5.41E-10	1.16E-05
U-233	9.68E-03	1.62E-05	1.57E-04	1.20E-06	1.17E-05
U-234	6.25E-03	1.58	9.90	0.118	0.735
U-235	2.16E-06	206	0.445	0.153	0.0331
U-236	6.47E-05	0.977	0.0632	0.0726	4.69E-03
U-238	3.36E-07	29,800	10.0	2,210	0.745

Notes:

[1]Agnew et al. (1997a)

[2]U_{TOTAL} is in kg from Table D3-4. Other data is calculated by ratio from HDW values.

Table D3-6. Calculation of Total Alpha Inventory for Tank 241-B-107.

Phase	Parameter	Value	Units
1C	Total alpha concentration[1]	0.0711	µCi/g
	Density[2]	1.63	g/mL
	Volume	310 (82)	kL (kgal)
	Total alpha inventory	36.0	Ci
BSltCk	Total alpha concentration[1]	0.0400	µCi/g
	Density[2]	1.70	g/mL
	Volume[3]	310 (82)	kL (kgal)
	Total alpha inventory	21.1	Ci
Total	Total alpha inventory	57.1	Ci

Notes:

[1]From Table B2-58

[2]From Table B2-56

[3]As no radionuclide estimates exist for the high aluminum/cladding waste, the BSltCk radionuclide estimates were assumed for this phase. The combined volume estimate for these two phases is used here.

Table D3-7. Inventory Calculations for Non-Uranium Alpha Contributors for Tank 241-B-107.

Alpha Contributor	HDW Model Inventory[1] (Ci)	Adjusted Inventory[2] (Ci)
U_{TOTAL}	20.4	1.52
Total alpha	31.5	57.1
Net alpha (Non-U)	11.1	55.6
^{238}Pu	0.0334	0.167
^{239}Pu	10.4	52.1
^{240}Pu	0.615	3.08
^{241}Pu[3]	0.405	2.03
^{242}Pu	1.24E-06	6.20E-06
^{241}Am	0.0209	0.105
^{243}Am	7.89E-08	3.95E-07
^{242}Cm	2.38E-05	1.19E-04
^{243}Cm	4.29E-07	2.15E-06
^{244}Cm	2.97E-06	1.49E-05

Notes:

[1]Agnew et al. (1997)

[2]The adjusted inventory was calculated by ratio from HDW values.

[3]Not an alpha emitter. The calculation was based on the HDW ratio of ^{241}Pu to ^{240}Pu.

Table D3-8. Sample Inventory Calculations for Non-Alpha Contributors for Tank 241-B-107. (2 sheets)

Tank or Waste Type	Volume [kL (kgal)]	Best-Basis Inventory Estimate[1]		Engineering Estimate
		^{63}Ni (Ci)	^{137}Cs (Ci)	^{137}Cs (Ci)
1C Tanks				
241-BX-107	1,302 (344)	3.94	32,700	n/a
241-BX-112	626 (165)	8.96	42,200	n/a
241-C-110	708 (187)	1.53	18,500	n/a
241-T-104	1,673 (442)	6.64	428	n/a
241-T-107	655 (173)	1.4	12,200	n/a
Total 1C	4,964 (1,311)	22.5	106,000	20.0 μCi/g[2]
241-B-107 1C	310 (82)	1.5	7,200	8,690[3]

Table D3-8. Sample Inventory Calculations for Non-Alpha Contributors for Tank 241-B-107. (2 sheets)

Tank or Waste Type	Volume [kL (kgal)]	Best-Basis Inventory Estimate[1]		Engineering Estimate
		^{63}Ni (Ci)	^{137}Cs (Ci)	^{137}Cs (Ci)
BSltCk Tanks				
241-B-104	1,400 (370)	15.2	19,400	n/a
241-B-106	443 (117)	25	11,000	n/a
241-B-108	356 (94)	13.1	8,600	n/a
241-B-109	481 (127)	24.5	17,000	n/a
Total BSltCk	2,680 (708)	77.8	56,000	24.7 μCi/g[4]
241-B-107 BSltCk	310 (82)	9.0	6,060	13,000[5]
241-B-107 Total	621 (164)	10.5	13,400	21,700

Notes:

[1]The best basis inventory data for these tanks was taken from the Tank Characterization Database (LMHC 1998).

[2]Table D3-1

[3]Calculated using density of 1.4 g/mL from Table D3-1.

[4]From Table D3-3; corrected for 33.2 percent moisture.

[5]Calculated using density of 1.7 from Table D2-56 because no engineering estimate of density was available.

D4.0 DEFINE THE BEST-BASIS AND ESTABLISH COMPONENT INVENTORIES

Information about chemical, radiological, and/or physical properties is used to perform safety analyses, engineering evaluations, and risk assessment associated with waste management activities, as well as regulatory issues. These activities include overseeing tank farm operations and identifying, monitoring, and resolving safety issues associated with these operations and with the tank wastes. Disposal activities involve designing equipment, processes, and facilities for retrieving wastes and processing them into a form that is suitable for long-term storage/disposal.

Chemical and radiological inventory information are generally derived using three approaches: 1) component inventories are estimated using results of sample analyses, 2) component inventories are estimated using the HDW model based on process knowledge and historical information, or 3) a tank-specific process estimate is made based on process flowsheets, reactor fuel data, essential material usage, and other operating data.

An effort is underway to provide waste inventory estimates that will serve as the standard characterization for the various waste management activities (Hodgson and LeClair 1996). As part of this effort, an evaluation of chemical information for tank 241-B-107 was performed including the following.

- Analytical data for the 1997 push mode core samples (see Appendix B).
- Analytical and historical model data from five waste tanks (241-BX-107, 241-BX-112, 241-C-110, 241-T-104, and 241-T-107) which contain $BiPO_4$ process 1C solids. These tanks are expected to represent the $BiPO_4$ process 1C waste solids in tank 241-B-107 and are used as a basis for comparison with the 1997 core sample data for the 1C waste layer.
- Analytical data from three waste tanks (241-B-109, 241-S-111, and 241-U-110) which contain CW or remnants of cladding waste.
- Analytical and historical model data from four waste tanks (241-B-104, 241-B-106, 241-B-108, and 241-B-109) which contain BSltCk. These tanks are expected to represent the BSltCk solids in tank 241-B-107 and are used as a basis for comparison with the 1997 core sample data for the BSltCk waste layer.
- An inventory estimate generated by the HDW model (Agnew et al. 1997a).

The results of this evaluation support using the analytical data from the 1997 core samples from tank 241-B-107 as the primary basis for the best-estimate inventory for the tank for the following reasons.

- Sample data, if available, is generally preferable to estimates from tanks with similar wastes or from transfer models.
- The analytical concentrations of components in each of three waste types now estimated to be in the tank (1C, high aluminum/CW, and BSltCk) generally fall within the ranges observed in other analyses and historical model estimates.
- The TLM assumption of 1C solids for the entire tank is incorrect based on the analytical results for core 218.

Once the best-basis inventories were determined, the hydroxide inventory was calculated by performing a charge balance with the valences of other analytes. The charge balance approach is consistent with that used by Agnew et al. (1997a).

Tables D4-1 and D4-2 show the best-basis inventory estimates for tank 241-B-107. The inventory estimates for some chemical components are based on the sample results. For other chemicals, inventory results are partly or entirely based on engineering estimates derived from the average concentration of components in similar tanks. Where no sampling or engineering estimate exists, the HDW model results from similar tanks are used. Finally, inventories for a small number of components are revised based on process knowledge. Section D3.5 describes the derivation of the chemical inventory. The inventory values in Tables D4-1 and D4-2 are subject to change without notice. Refer to the Tank Characterization Database (LMHC 1998) for the most current inventory values.

Best-basis tank inventory values are derived for 46 key radionuclides (as defined in Section 3.1 of Kupfer et al. [1997]). All radionuclides were decayed to a common report date of January 1, 1994 to be consistent with the decay date used in the HDW model. Often, waste sample analyses have only reported ^{90}Sr, ^{137}Cs, $^{239/240}$Pu, and total uranium (or total beta and total alpha), while other key radionuclides such as ^{60}Co, ^{99}Tc, ^{129}I, ^{154}Eu, ^{155}Eu, and ^{241}Am, have been infrequently reported. For this reason, it has been necessary to derive most of the 46 key radionuclides by computer models. These models estimate radionuclide activity in batches of reactor fuel, account for the split of radionuclides to various separations plant waste streams, and track their movement with tank waste transactions. (These computer models are described in Kupfer et al. [1997] and in Watrous and Wootan [1997].) Model-generated values for radionuclides in any of 177 tanks are reported in Agnew et al. (1997a). The best-basis value for any one analyte may be either a model result or a sample or engineering assessment-based result (if available). For a discussion of typical errors between model-derived values and sample derived values, see Kupfer et al. (1997). As no applicable radionuclide data from the tank 241-B-107 samples were available, the radionuclide estimates were derived from reported data for similar tanks (see Section D3.6).

Table D4-1. Best-Basis Inventory Estimate for Nonradioactive Components in Tank 241-B-107 (Effective December 31, 1997).

Analyte	Total Inventory (kg)	Basis (S, M, C, or E)[1]	Comment
Al	28,100	S	
Bi	10,600	S	
Ca	547	S	
Cl	997	S	
TIC as CO_3	4,970	E	
Cr	286	S	
F	25,000	S	
Fe	15,900	S	
Hg	52.25	E	Simpson (1998)
K	510	S/E	Engineering estimate for BSltCk was used because the sample result was below detection limits.
La	0	S	Based on process history.
Mn	106	S	
Na	164,000	S	
Ni	40	S	"Less than" used.
NO_2	3,410	S	
NO_3	151,000	S	
OH_{TOTAL}	46,400	C	
Pb	515	S	
PO_4	76,600	S	
Si	5,850	S	
SO_4	86,700	S	
Sr	121	S	"Less than" used.
TOC	408	E	No high Al/CW or BSltCk data; no estimate for half of tank.
U_{TOTAL}	2,230	S	
Zr	133	S	

Note:
[1]S = sample-based, M = HDW model-based, E = engineering assessment-based, and C = calculated by charge balance; includes oxides as "hydroxide" not including CO_3, NO_2, NO_3, PO_4, SO_4, and SiO_3.

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-107 Decayed to January 1, 1994 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (Ci)[1]	Basis (S, M, or E)[2]	Comment
^{3}H	3.58	E	
^{14}C	0.603	E	Engineering estimate used. "Less than" used in calculation.
^{59}Ni	0.115	E	
^{60}Co	8.17	E	Engineering estimate used. "Less than" used in calculation.
^{63}Ni	10.4	E	
^{79}Se	0.143	E	
^{90}Sr	38,100	E	Engineering estimate used.
^{90}Y	38,100	E	Based on ^{90}Sr.
^{93m}Nb	0.221	E	
^{93}Zr	0.289	E	
^{99}Tc	17.5	E	Engineering estimate used. "Less than" used in calculation.
^{106}Ru	8.43E-05	E	
^{113m}Cd	1.29	E	
^{125}Sb	3.03	E	
^{126}Sn	8.89E-02	E	
^{129}I	7.93	E	
^{134}Cs	3.26	E	
^{137m}Ba	20,500	E	Based on ^{137}Cs.
^{137}Cs	21,700	E	Engineering estimate used.
^{151}Sm	214	E	
^{152}Eu	5.66E-02	E	
^{154}Eu	29.9	E	Engineering estimate used. "Less than" used in calculation.
^{155}Eu	46.2	E	Engineering estimate used. "Less than" used in calculation.
^{226}Ra	7.76E-06	E	
^{227}Ac	9.82E-04	E	
^{228}Ra	1.06E-02	E	

Table D4-2. Best-Basis Inventory Estimate for Radioactive Components in Tank 241-B-107 Decayed to January 1, 1994 (Effective December 31, 1997). (2 sheets)

Analyte	Total Inventory (Ci)[1]	Basis (S, M, or E)[2]	Comment
^{229}Th	3.78E-04	E	
^{231}Pa	1.51E-03	E	
^{232}Th	1.28E-03	E	
^{232}U	1.16E-05	S/M	Based on U total; uses HDW isotopic ratios.
^{233}U	1.17E-05	S/M	Based on U total; uses HDW isotopic ratios.
^{234}U	0.735	S/M	Based on U total; uses HDW isotopic ratios.
^{235}U	0.0331	S/M	Based on U total; uses HDW isotopic ratios.
^{236}U	4.69E-03	S/M	Based on U total; uses HDW isotopic ratios.
^{237}Np	1.84E-02	E	
^{238}Pu	0.167	S/M	Based on total alpha; uses HDW isotopic ratios.
^{238}U	0.745	S/M	Based on U total; uses HDW isotopic ratios.
^{239}Pu	52.1	S/M	Based on total alpha; uses HDW isotopic ratios.
^{240}Pu	3.08	S/M	Based on total alpha; uses HDW isotopic ratios.
^{241}Am	0.105	S/M	Based on total alpha; uses HDW isotopic ratios.
^{241}Pu	2.03	S/M	Based on total alpha; uses HDW isotopic ratios.
^{242}Cm	1.19E-04	S/M	Based on total alpha; uses HDW isotopic ratios.
^{242}Pu	6.20E-06	S/M	Based on total alpha; uses HDW isotopic ratios.
^{243}Am	3.95E-07	S/M	Based on total alpha; uses HDW isotopic ratios.
^{243}Cm	2.15E-06	E/M	Based on total alpha; uses HDW isotopic ratios.
^{244}Cm	1.49E-05	E/M	Based on total alpha; uses HDW isotopic ratios.

Notes:

[1]All data except uranium isotopes were derived from other tanks.

[2]S = sample-based, M = HDW model-based, and E = engineering assessment-based

D5.0 APPENDIX D REFERENCES

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-B-107

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APPENDIX E

BIBLIOGRAPHY FOR TANK 241-B-107

Appendix E provides a bibliography that supports the characterization of tank 241-B-108. This bibliography represents an in-depth literature search of all known information sources that provide sampling, analysis, surveillance, and modeling information, as well as processing occurrences associated with tank 241-B-107 and its respective waste types.

The references in this bibliography are separated into three broad categories containing references broken down into subgroups. These categories and their subgroups are listed below.

I. NON-ANALYTICAL DATA

- Ia. Models/Waste Type Inventories/Campaign Information
- Ib. Fill History/Waste Transfer Records
- Ic. Surveillance/Tank Configuration
- Id. Sample Planning/Tank Prioritization
- Ie. Data Quality Objectives/Customers of Characterization Data

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

- IIa. Sampling of tank 241-B-107
- IIb. Sampling of similar waste types

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

- IIIa. Inventories using both Campaign and Analytical Information
- IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

This bibliography is broken down into the appropriate sections of material to use, with an annotation at the end of each reference or set of references describing the information source. A majority of the information listed below is available in the Lockheed Martin Hanford Corp. Tank Characterization and Safety Resource Center.

I. NON-ANALYTICAL DATA

Ia. Models/Waste Type Inventories/Campaign Information

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Contains single-shell tank fill history and primary campaign/waste type information up to 1981.

Jungfleisch, F. M., and B. C. Simpson, 1993, *Preliminary Estimation of the Waste Inventories in Hanford Tanks Through 1980*, WHC-SD-WM-TI-057, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Describes a model for estimating tank waste inventories using process knowledge, radioactive decay estimates using ORIGEN, and assumptions about waste types, solubility, and constraints.

Schneider, K. J., 1951, *Flowsheets and Flow Diagrams of Precipitation Separations Process*, HW-23043, Hanford Atomic Products Operation, Richland, Washington.

- Contains compositions of process stream waste before transfer to 200 Area waste tanks.

Ib. Fill History/Waste Transfer Records

Agnew, S. F., P. Baca, R. A. Corbin, T. B. Duran, and K. A. Jurgensen, 1996, *Waste Status and Transaction Record Summary, WSTRS Rev. 4*, LA-UR-97-311, Rev. 0, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains spreadsheets showing all known tank additions and transfers.

Anderson, J. D., 1990, *A History of the 200 Area Tank Farms*, WHC-MR-0132, Westinghouse Hanford Company, Richland, Washington.

- Contains tank fill histories and primary campaign and waste type information up to 1981.

Ic. Surveillance/Tank Configuration

Alstad, A. T., 1993, *Riser Configuration Document for Single-Shell Waste Tanks*, WHC-SD-RE-TI-053, Rev. 9, Westinghouse Hanford Company, Richland, Washington.

- Shows riser locations in relation to tank aerial view and provides a description of each riser and its contents.

Lipnicki, J., 1997, *Waste Tank Risers Available for Sampling*, WHC-SD-WM-TI-710, Rev. 4, Westinghouse Hanford Company, Richland, Washington.

- Provides an assessment of riser locations for each tank, however, not all tanks are included/completed. Also estimates the risers available for sampling.

Tran, T. T., 1993, *Thermocouple Status Single-Shell & Double-Shell Waste Tanks*, WHC-SD-WM-TI-553, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Provides thermocouple location and status information for double- and single-shell tanks.

Welty, R. K., 1988, *Waste Storage Tank Status and Leak Detection Criteria*, WHC-SD-WM-TI-356, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Provides leak detection information for all single- and double-shell tanks. Includes liquid level, liquid observation well, and dry well readings.

Id. Sample Planning/Tank Prioritization

Brown, T. M., J. W. Hunt, and L. J. Fergestrom, 1997, *Tank Characterization Technical Sampling Basis*, HNF-SD-WM-TA-164, Rev. 3, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Establishes an approach to determine the priority for tank sampling and characterization and identifies high-priority tanks for sampling.

Conner, J. M., 1997, *Tank 241-B-107 Push Mode Core Sampling and Analysis Plan*, HNF-SD-WM-TSAP-144, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington..

- Contains a detailed sampling and analysis scheme for core samples to be taken from tank 241-B-107 to address applicable DQOs.

Mulkey, C. H., 1996, *Single-Shell Tank System Waste Analysis Plan*, WHC-EP-0356, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- This is the waste analysis plan for single-shell tanks as required by the *Washington Administrative Code* (WAC-173-303) and the *Code of Federation Regulations* (40 CFR Part 265).

Stanton, G. A., 1997, *Baseline Sampling Schedule, Change 97-03*, (internal letter 75610-97-004 to Distribution, October 8), Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Provides a tank waste sampling schedule through Fiscal Year 2002 and lists samples taken since 1994.

Winkelman, W. D., 1996, *Tank 241-B-107 Tank Characterization Plan*, WHC-SD-WM-TP-517, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Discusses relevant DQOs and how their requirements will be met for tank 241-B-107.

Winkelman, W. D., M. R. Adams, T. M. Brown, J. W. Hunt, D. J. McCain, and L. J. Fergestrom, 1997, *Fiscal Year 1997-1998 Waste Information Requirements Document*, HNF-SD-WM-PLN-126, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains requirements and planned characterization activities from sources such as the *Hanford Federal Facility Agreement and Consent Order* and the *Recommendation 93-5 Implementation Plan* for Fiscal Years 1997 and 1998.

Ie. Data Quality Objectives/Customers of Characterization Data

Dukelow, G. T., J. W. Hunt, H. Babad, and J. E. Meacham, 1995, *Tank Safety Screening Data Quality Objective*, WHC-SD-WM-SP-004, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Determines whether tanks are under safe operating conditions.

Osborne, J. W., and L. L. Buckley, 1995, *Data Quality Objective for Tank Hazardous Vapor Safety Screening*, WHC-SD-WM-DQO-002, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

- Determines whether tank headspaces contain potentially hazardous gases and vapors.

Schreiber, R. D., 1997, *Memorandum of Understanding for the Organic Complexant Safety Issue Data Requirements*, HNF-SD-WM-RD-060, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains organic program data needs, list of tanks to be evaluated, decision thresholds, and a decision logic flow diagram.

II. ANALYTICAL DATA - SAMPLING OF TANK WASTE AND WASTE TYPES

Iia. Sampling of tank 241-B-107

Evans, J. C., K. H. Pool, B. L. Thomas, K. B. Olsen, J. S. Fruchter, K. L. Silvers, 1997, *Tanks Vapor Characterization Project, Headspace Vapor Characterization of Hanford Waste Tank 241-B-107: Results from Samples Collected on 07/23/96*, PNNL-11268, Pacific Northwest National Laboratory, Richland, Washington.

- Contains vapor sampling analysis results from the July 1996 sampling event.

Horton, J. E., 1976, *Analysis of 107-B Sludge*, (internal letter to W. R. Christensen, April 8), Atlantic Richfield Hanford Company, Richland, Washington.

- Contains sludge sampling analysis results from January 1976 sampling event.

Horton, J. E., 1976, *Concentration Laboratory Assistance* (internal letter to D. C. Lini, April), Westinghouse Hanford Company, Richland, Washington.

- Contains sludge sampling analysis results from January 1976 sampling event for tank 241-B-107 and sampling analysis results for several other tanks.

Nuzum, J. L., 1997, *Tank 241-B-107, Cores 217 and 218 Analytical Results for the Final Report*, HNF-SD-WM-DP-269, Rev. 0, Waste Management Federal Services of Hanford, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains sampling analysis results from the August and September 1997 push mode sampling event for tank 241-B-107.

IIb. Sampling of Similar Waste Types

Benar, C. J., 1997, *Tank Characterization Report for Single-Shell Tank 241-C-110*, HNF-SD-WM-ER-367, Rev. 1A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the 1C waste type.

Brown, T. M., and L. Jensen, 1993, *Tank Characterization Report for Single-Shell Tank 241-U-110*, WHC-EP-0643, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains information on high aluminum waste.

Conner, J. M., 1997, *Tank Characterization Report for Single-Shell Tank 241-S-111*, HNF-SD-WM-ER-638, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on high aluminum waste.

Field, J. G., and B. A. Higley, 1997, *Tank Characterization Report for Single-Shell Tank 241-B-104*, WHC-SD-WM-ER-552, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the BSltCk waste type.

Sasaki, L. M., 1997, *Tank Characterization Report for Single-Shell Tank 241-T-107*, HNF-SD-WM-ER-382, Rev. 1A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the 1C waste type.

Sasaki, L. M., J. D. Franklin, J. L. Stroup, L. Jensen, and R. T. Winward, 1997, *Tank Characterization Report for Single Shell Tank 241-T-104*, HNF-SD-WM-ER-372, Rev. 1, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on 1C waste type.

Schreiber, R. D., 1997, *Tank Characterization Report for Single-Shell Tank 241-B-108*, HNF-SD-WM-ER-674, Rev. 0B, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the BSltCk waste type.

Winkelman, W. D., 1997, *Tank Characterization Report for Single-Shell Tank 241-BX-107*, HNF-SD-WM-ER-539, Rev. 1, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the 1C waste type.

Winkelman, W. D., and B. J. Morris, 1996, *Tank Characterization Report for Single-Shell Tank 241-BX-112*, WHC-SD-WM-ER-602, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains information on the 1C waste type.

McCain, D. J., 1996, *Tank Characterization Report for Single-Shell Tank 241-B-106*, WHC-SD-WM-ER-601, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains information on the BSltCk waste type.

Benar, C. J., 1997, *Tank Characterization Report for Single-Shell Tank 241-B-109*, HNF-SD-WM-ER-677, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the CW and BSltCk waste types.

Baldwin, J. H., 1997, *Tank Characterization Report for Single-Shell Tank 241-T-102*, HNF-SD-WM-ER-601, Rev. 0A, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains information on the CW waste type.

III. COMBINED ANALYTICAL/NON-ANALYTICAL DATA

IIIa. Inventories using both Campaign and Analytical Information

Agnew, S. F., J. Boyer, R. A. Corbin, T. B. Duran, J. R. Fitzpatrick, K. A. Jurgensen, T. P. Ortiz, and B. L. Young, 1997, *Hanford Tank Chemical and Radionuclide Inventories: HDW Rev. 4*, LA-UR-96-3860, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Contains waste type summaries, primary chemical compound/analyte and radionuclide estimates for sludge, supernatant, and solids, as well as SMM, TLM, and individual tank inventory estimates.

Agnew, S. F., R. A. Corbin, J. Boyer, T. B. Duran, K. A. Jurgensen, T. P. Ortiz, B. L. Young, R. Anema, and C. Ungerecht, 1996, *History of Organic Carbon in Hanford HLW Tanks: HDW Model Rev. 3*, LA-UR-96-989, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Attempts to account for the disposition of soluble organics and provides estimates of TOC content for each tank.

Allen, G. K., 1976, *Estimated Inventory of Chemicals Added to Underground Waste Tanks, 1944 - 1975*, ARH-CD-601B, Rev. 0, Atlantic Richfield Hanford Company, Richland, Washington.

- Contains major components for waste types and some assumptions. Purchase records are used to estimate chemical inventories.

Allen, G. K., 1975, *Hanford Liquid Waste Inventory as of September 30, 1974*, ARH-CD-229, Rev. 0, Atlantic Richfield Company, Richland, Washington.

- Contains major components for waste types and some assumptions.

Klem, M. J., 1988, *Inventory of Chemicals Used at Hanford Production Plants and Support Operations (1944 - 1980)*, WHC-EP-0172, Westinghouse Hanford Company, Richland, Washington.

- Provides a list of chemicals used in production facilities and support operations that sent wastes to the single-shell tanks. The list is based on chemical process flowsheets, essential materials consumption records, letters, reports, and other historical data.

Kupfer, M. J., 1997, *Preliminary Tank Characterization Report For Single-Shell Tank 241-B-107 Best Basis Inventory*, HNF-SD-WM-ER-723, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains a component inventory for tank 241-B-107 and inventories 21 chemical and approximately 40 radionuclide components.

Kupfer, M. J., M. J. Boldt, A. L. Higley, K. M. Hodgson, L. W. Shelton, B. C. Simpson, R. A. Watrous, M. D. LeClair, G. L. Borsheim, R. T. Winward, R. M. Orme, N. G. Colton, S. L. Lambert, D. E. Place, and W. W. Schultz, 1997, *Standard Inventories of Chemicals and Radionuclides in Hanford Site Tank Wastes*, HNF-SD-WM-TI-740, Rev. 0, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains a global and tank-by-tank component inventory for 200 Area waste tanks and inventories 21 chemical and approximately 40 radionuclide components.

Schmittroth, F. A., 1995, *Inventories for Low-Level Tank Waste*, WHC-SD-WM-RPT-164, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Contains a global inventory based on process knowledge and radioactive decay estimations using ORIGEN2. Plutonium and uranium waste contributions are taken at 1 percent of the amount used in processes. Also compares information on Tc-99 from both ORIGEN2 and analytical data.

IIIb. Compendium of Existing Physical and Chemical Documented Data Sources

Agnew, S. F., and J. G. Watkin, 1994, *Estimation of Limiting Solubilities for Ionic Species in Hanford Waste Tank Supernates*, LA-UR-94-3590, Los Alamos National Laboratory, Los Alamos, New Mexico.

- Gives solubility ranges for key chemical and radionuclide components based on supernatant sample analyses.

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Historical Tank Content Estimate for the Northeast Quadrant of the Hanford 200 East Area*, WHC-SD-WM-ER-349, Rev. 1B, Westinghouse Hanford Company, Richland, Washington.

- Contains summary information for tanks in B, BX, and BY Tank Farms and in-tank photograph collages.

Brevick, C. H., J. L. Stroup, and J. W. Funk, 1997, *Supporting Document for the Northeast Quadrant Historical Tank Content Estimate Report for B Tank Farm*, WHC-SD-WM-ER-310, Rev. 1B, Fluor Daniel Northwest, Inc. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Contains summary information for tanks in the B Tank Farm and appendices containing more detailed information including tank waste level history, tank temperature history, cascade and dry well charts, riser information, in-tank photograph collages, and a tank layer model bar chart and spreadsheet.

Brevick, C. H., L. A. Gaddis, and E. D. Johnson, 1996, *Tank Waste Source Term Inventory Validation, Vol I, II, and III*, WHC-SD-WM-ER-400, Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

- Contains a quick reference to sampling information in spreadsheet or graphical form for 24 chemicals and 11 radionuclides for all tanks.

Hanlon, B. M., 1997, *Waste Tank Summary Report for Month Ending August 31, 1997*, HNF-EP-0182-113, Lockheed Martin Hanford Corp. for Fluor Daniel Hanford, Inc., Richland, Washington.

- Updated monthly, this document contains a summary of tank waste volumes, Watch List tanks, occurrences, tank integrity information, equipment readings, tank location, leak volumes, and other miscellaneous tank information.

Hill, J. G., G. S. Anderson, and B. C. Simpson, 1995, *The Sort on Radioactive Waste Type Model: A Method to Sort Single-Shell Tanks into Characteristic Groups*, PNL-9814, Rev. 2, Pacific Northwest Laboratory, Richland, Washington.

- Describes a system of sorting single-shell tanks into groups based on major waste types contained in each tank.

Husa, E. I., 1993, *Hanford Site Waste Storage Tank Information Notebook*, WHC-EP-0625, Westinghouse Hanford Company, Richland, Washington.

- Contains in-tank photographs and summaries of the tank descriptions, leak detection systems, and tank status.

Husa, E. I., 1995, *Hanford Waste Tank Preliminary Dryness Evaluation*, WHC-SD-WM-TI-703, Rev. 0, Westinghouse Hanford Company, Richland, Washington.

- Gives an assessment of the relative dryness of tank wastes.

Shelton, L. W., 1996, *Chemical and Radionuclide Inventory for Single- and Double-Shell Tanks*, (internal memorandum 74A20-96-30 to D. J. Washenfelder, February 28), Westinghouse Hanford Company, Richland, Washington.

- Contains a tank inventory estimate based on analytical information.

Shelton, L. W., 1995, *Chemical and Radionuclide Inventory for Single and Double Shell tanks*, (internal memorandum 75520-95-007 to R. M. Orme, August 8), Westinghouse Hanford Company, Richland, Washington.

- Contains a tank inventory estimate based on analytical information.

Shelton, L. W., 1995, *Radionuclide Inventories for Single and Double Shell Tanks*, (internal memorandum 71320-95-002 to F. M. Cooney, February 14), Westinghouse Hanford Company, Richland, Washington.

- Contains a tank inventory estimate based on analytical information.

Van Vleet, R. J., 1993, *Radionuclide and Chemical Inventories for the Single-Shell Tanks*, WHC-SD-WM-TI-565, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

- Contains selected sample analysis tables before 1993 for single-shell tanks.

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